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EDITOR & PUBLISHER: WALTER KING. OFFICE: 11, BOLT COURT, FLEET ST., LONDON.

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EDITORIAL NOTES—GAS, &c.

Tar for Road Purposes.

Is the gas industry really doing anything to assist in cultivating the utilization of tar for road construction or surfacing, as suggested by Sir George Livesey, and thus contributing to the opening up of a new and permanent outlet for this low-valued product, to the improvement of its price, and to the enhancement of the sum of human happiness by restoring, as far as is possible under the new conditions, the attractions of our suburban and country roadways? Most of the work that is being done in this direction appears to have been initiated by road surveyors and borough and county engineers, while those directing gas undertakings who have the principal and most popular fluid for sale for coating road surfaces and generally improving the roads, are apparently sitting quietly by, waiting for whatever may turn up, and glad indeed to do any increased business that others by their exertions may bring them. If this is not the case, then the administrations of gas undertakings are working in this matter with such profound secrecy that no one obtains intelligence as to what they are doing. This is a business that requires watching, fostering, and assisting as much as possible, because, if successful, it is not going to be a thing merely for to-day or to-morrow, but a lasting outlet. There is a danger, if inertia, supineness, or only a distant interest are allowed to take the place of that intimacy on the part of gas managements that there should be in a matter of this kind, that again the gas industry will be deprived of the direct business that appears likely in this connection, and that the tar will pass through second hands and be subjected to other, and perhaps altogether unnecessary, treatment, which, owing to the increased price, may be derogatory to its extended use. If this should happen, gas-works will still be left with the old, monotonous prices for tar which have for years swerved but little from current prices, excepting for a few months in 1903 and 1904. What those directing gas undertakings have to do is to perform their part in proving that their commodity as they sell it, without any other treatment than merely heating up if preferred, is all that is necessary for its use upon roads. Tar is being widely tried; and the evidence that has been gathered and published since Sir George Livesey's appeal, at the Institution meeting, for encouragement to this new outlet, gives strong hope that the use of tar for this purpose has come to stay. Who is going to supply the tar?

This is in essence an economic question for gas undertakings. There has been a great increase in the output of tar, through the largely augmented, and ever increasing, carbonization of coal, both within and outside the industry; and what is produced outside the industry, naturally affects the markets of gas undertakings. Over such external influences there can, of course, be no control. Within the industry, the yield of tar has not increased *pari passu* with the addition to the output of gas; and, indeed, in some large centres, the past few years have shown an actual decline in the tar output—due to the use of carburetted water gas, and to improved carbonizing results in respect of gas yield. As an instance of this, we may take London, where, although the demand for gas is considerably greater now than it was five years ago, the output of tar by the three Companies is more than 1¼ million gallons less—that is to say, in the twelve months ending June, 1901, the output of the three Companies was 31,795,729 gallons, as compared with 30,523,988 gallons in the twelve months ending June 30 last. The Gaslight and Coke Company—who are the heaviest producers of carburetted water gas—show, comparing the two periods named, a decline of 2,391,161 gallons of tar; while the South Metropolitan Gas Company increased their output by 871,626 gallons, and the Commercial Company theirs by 247,794 gallons. But the mistake must not be made of applying any such test as this in an attempt to disprove that the supply of tar is not making that headway in quantity which enables the distillers to continue to name their own miserable price for the commodity—the price itself is a concrete fact attesting over-production. Any year, through adventitious circumstances, might alter the aspect of the above comparative figures for the Metropolis. The experience there is not normal throughout the country; and there are the large tributary supplies from other quarters. There are, too, gas engineers who are finding that, with improved carbonizing plant, coal and coke handling plant, and reduced labour costs, they can make coal gas to-day cheaper than carburetted water gas. One gas engineer only a few days since informed us that he has already made arrangements, for this very reason, to use his carburetted water-gas plant only to carry him over the highest peaks of the winter's load. His production of coal tar—true, his works are not extensive—will be so much more than in several previous winters. But this only by way of illustration.

These points are put thus to impress this tar question as being one over which there should not be any leisurely attitude. The question of the improvement of road surfaces, and the suppression of the stifling dust occasioned by modern vehicular traffic, has been forced upon the attention of those responsible for the well-being of the roads and the reasonable comfort of those who use them. It is a matter that is very much alive among them at the present time. This is therefore our opportunity; and listlessness from the gas industry's side will not do. Ordinary gas-works tar has to be defended, and that promptly. Contrary to testimony from elsewhere, Mr. H. P. Maybury, formerly one of our Midland Gas Engineers, now the County Surveyor for Kent, has told the Royal Commission on Motor Cars, that "ordinary "gas-works tar" for road purposes "has been an absolute "failure, though put on in the same way as distilled tar." He also asserts that gas-works tar "peels off the road like "sheets of paper." Mr. Maybury advocates the use of tar for the purpose; but it must be for him a distilled tar, specially prepared, for which he has been paying 3½d. per gallon. Unless we are mistaken, the tar that Mr. Maybury prefers will reach the roads from the gas-works *viâ* the tar distillers. If this is so, and Mr. Maybury's view should ultimately be that generally accepted by the road authorities, who again would get the best picking from this new use of tar? There is only one answer, if we are correct; and that is not what is wanted from the point of view of the gas industry. The idea is that this new outlet should be constituted, by selling tar for the purpose at a cheap rate, the way to the relief of the tar market, and to higher prices from the tar distillers. This is where the gas manager must step in, to save the direct business that is to be done. Mr. Maybury's evidence is not that of all county or other road surveyors; and so gas managers would be doing the whole industry, including themselves, a service by sending to us for publication any experiences from their districts as to the employment of ordinary gas-works tar in this direction. This is a matter in which the more publicity there is, the greater the good. Why, too, should not gas-works make little experiments on their own account and on their own property, so as to enable them to advise?

During the last couple of months, the information on the subject published in the "JOURNAL" has been very instructive, as to application, cost, durability, effectiveness, savings, and so on. Before applying the tar, the roadway must be swept and cleaned; and it is best to apply the tar in dry weather—preferably in the spring, ready for the summer season. As to cost, Mr. Maybury puts it, with his "distilled, specially-prepared" tar, at 1¼d. per square yard for two coats, or about £60 per mile. Mr. Maxwell, of Tunbridge Wells, gives the cost of the first coat for oil-gas tar at ½d. per square yard. Mr. H. W. Smith, at the meeting of the Association of Municipal and County Engineers, calculates the cost as being 1¼d. per square yard, including

tarring, dusting, and small repairs in preparation. Another witness says that the average quantity of tar required is 0·45 gallon per square yard. But when considering these figures, it must be remembered that these are initial costs, and that, in succeeding years, the expense of a fresh application would not be so great. Against the cost, too, has to be set the preservative effect, the reduction of wear and tear on the roads, and the saving of the big cost of road watering. The annihilation of a nuisance is worth something to the public, and to those whose houses and gardens are situated on main roads. The tarring under proper conditions gives quite an asphalte-like condition to the surface, and is an improvement for pedestrians in wet weather. As to durability, there is evidence that the treatment of roads in spring will suffice for the whole season; and the following year the work is cheapened by not having to be done *de novo*. The South Metropolitan Gas Company have advised all the road authorities in their area as to the terms upon which they can have tar for this purpose; and the Kent County Council have circularized urban and rural authorities in their area, offering a contribution of ½d. per square yard to the tar-painting of their main roads, providing it is done in a workmanlike manner. Several have accepted the offer. There are many hints now to be picked up whereby this new outlet may be encouraged by the expenditure of a little trouble. Lethargy has never proved itself to be a germ of success.

Progress in the Suburbs—Croydon Experiences.

THERE is a striking resemblance between Tottenham of the northern suburbs of London and Croydon of the southern ones in respect of gas supply—so strikingly alike indeed that the greater part of the remarks made on the Tottenham Gas Company last week could with propriety be applied to Croydon. No matter, in fact, in which direction we look much the same prosperous experiences are found among nearly all the gas concerns operating in that zone which lies between that which we call Metropolitan and that which is known as Provincial. A period of great development has been entered upon in that zone; and districts that until recent years were in large parts composed of fields, lanes, and hedgerows—truly rural it may be said—are, by the hand of the builder, being fast converted into residential districts that have an influential bearing upon, among other branches of local industry and commerce, the gas supply. Take the address delivered by Mr. Charles Hussey at the meeting of the Croydon gas proprietors on Friday. It was as pregnant in interest as the district is in new business in gas supply—municipal electrical competition notwithstanding. They were wise strokes that betimes brought about the annexation of the Carshalton and the Caterham districts to that of the Croydon Company. The consumers of these outlying districts are enjoying an immediate benefit from being linked up to the premier concern; and the consumers of Croydon and the proprietors of the Company have well-founded hopes of participating, in due season, in the fruits of the development of these areas.

Here at Croydon, again, for many years past there has been no rest from additions and modernization work owing to accretions of consumption (7·7 per cent. last half year, compared with the corresponding half of 1905); much additional capital has had to be expended; and a new section of works, excepting for carbonization, has already been commenced. Yet the consumers have benefited in reduced prices, and there has been consequential improvement in dividend, but the amount asked for dividend and interest per 1000 cubic feet of gas sold has declined. These are the effects of coherent circumstances—expanding business, modern methods, and persevering work both within and outside the producing establishment. There is one great lesson that Mr. J. W. Helps has learnt from his experiences at Croydon, that the success of a gas business nowadays depends on the distribution department quite as much as, if not more than, upon the manufacturing department. Anyway, the responsibility in the distribution department, though it may be of a more attenuated character than in the manufacturing department, is more extensive—being limited only by the boundary line of the supply area. The relationship of the numbers of men engaged in the two departments is also changing; and where machinery is enabling a greater amount of work to be done *per capita* than formerly, and so requiring less men about a works per unit of production than before, the distribution department has opened up healthy and responsible occupations for a considerable number of intelligent men. This is a movement that will continue—due partly to the two essentials of producing gas as cheaply as possible, and (added to the character of modern gas business) of, through the staff, taking all possible offensive and defensive measures in connection with competition. These essentials have reciprocal tendencies. On all these points there are many particulars to be gathered from the Croydon meeting.

Another feature of the meeting requires allusion. To the Company's operations, the sliding-scale is applied; but they have not seen fit yet to convert and consolidate their stocks. The weight and price of the stocks make them almost prohibitive for encouraging financial interest among the smaller consumers. But the Company, under their Act of 1904, introduced into their capital a new class of stock, to which the sliding-scale will only apply in the downward direction, and such disturbance of the dividend can only be brought about by conditions that, from present appearances, will never really exist. It is a 5 per cent. maximum dividend stock; and so from 5 per cent. there will never be progression and only recession when, if ever, the dividend on the "B" stock is brought below 5 per cent., and the dividend on that stock now stands at 11½ per cent.! The difference between the 5 and the 11½ per cent. is so great as to cause the likelihood of coincidence to completely vanish. This stock with its stationary dividend of 5 per cent., and a market value not far removed from its nominal one, is to be offered (the first issue will be made shortly) to the consumers, by whom investments can be made down to quite small sums. This financial attachment of the interest of consumers is one of those effective weapons private gas enterprise holds, and property in which cannot be claimed by the municipal electric lighting department. A municipal trading department has really no distinctive capital that it can offer to the consumers for investment, and the interest paid on the common stock has no comparison with that paid by a progressive gas undertaking, and so is not inviting. The principle of co-operation and mutual benefit between producer and consumer is a sound one, and that principle, introduced by the sliding-scale, is broadening in its application year by year, and in equal measure is strengthening private gas enterprise to the detriment of the municipal producer of electricity. The Croydon Gas Company, among other gas undertakings, have excellent prospects; and both proprietors and consumers are to be heartily congratulated upon them.

The Question of Electrolysis—
A Departmental Inquiry Suggested.

CONSIDERATION was given in the "JOURNAL" recently to the increasing liability to which gas undertakers have become exposed, in connection with their distribution systems, by the advent and spreading application of the modern conveniencies of communities, such as electrical and telephone systems. Of this gas suppliers would not complain if there was equitable treatment. Disturbance of mains, services, and the subsoil by the work inherent to these newer systems, favours the escape of gas; and certain of these latter-day arrivals, while themselves encouraging the leakage of gas, afford, unless their designers take precautions, harbours for accumulations of gas such as was formerly unknown, and which sometimes effect injury—as in the Regent Street telephone-box case—for which gas distributors are accounted legally liable, though the explosion may have been due to the act of some person over whom they have no control, and even though that person or his employers may have been fully aware of the presence of gas. That is the reading of the law by the Judges of the High Court. There is a curious inconsistency between this interpretation of the law as against gas undertakings and the views of Parliament and the Board of Trade as to the righteousness of a specific declaration of the liability of electricity undertakings for damage resulting from their operations to the canalization of gas undertakings. There is here an iniquitous handling of the scales of justice as between gas and electricity distributors. The law says that liability for any damage occasioned by an explosion of gas leaking from the distribution system shall rest upon the gas suppliers. Parliament and the Board of Trade say they will not specifically put upon electricity distributors the liability for damage to underground pipes caused by leakages of

electricity. In other words, gas (by the law and by Parliament) is made the butt all round.

The last refusal of Parliament to give further protection to both gas and water distributors was in connection with the widening of Blackfriars Bridge for the purpose of extending electric traction, and linking up the tramways sytems of London. The insertion of a clause, imposing liability for compensation on those concerned in the event of damage to pipes, was moved in the House of Lords by Lord Welby. But his proposal was rejected on two grounds—first, that by a decision of the House, two years or so ago, the question was left to the regulation of the Board of Trade, and, secondly, that there should be uniformity of practice. With regard to the Board of Trade, there have been, it cannot be denied, consistent prejudice shown by them in the matter, and what appears to be a devout belief in the sufficiency of the regulations which were framed as a result of the inquiry by Lord Cross's Committee in 1893, compliance with which regulations it is nobody's business to see fulfilled. No better means of ensuring that the utmost care is taken to prevent the straying of currents from electrical systems could be devised than the definite imposing by the Legislature upon electricity distributors of liability for resulting damage. It is really a serious matter for gas undertakers, when full liability for explosions contributed to by others is inflicted upon them; and more so now that the House of Lords avow that gas distributors have no appeal from a biassed Board of Trade to Imperial Parliament. It is not a comfortable reflection that such devolution of their responsibility by the House of Lords places an inexorable Government Department in the position of absolute arbiters in a matter involving such grave liability. Lord Newton, in the course of the debate over Lord Welby's proposal referred to above, made the very practical suggestion that the Board of Trade should now appoint a Departmental Committee to ascertain the actual rights in the matter, in order that Parliament may have some guidance in the future. It is thirteen years since Lord Cross's Committee had the question under inquiry. Times have changed considerably since then. Electricity systems are crowding our streets—lighting, traction, and power; and it is high time there was further investigation. If the risk has increased, protection also requires to be increased.

The second reason animating the Lords in refusing the clause moved for by Lord Welby was a peculiar anxiety for consistency of practice in this regard. Their Lordships were heedless of the fact that, only a few days before, they instanced their own inconsistency by granting to the Borough Councils of London, through the County Council, the very electric wiring clauses that but twelve months previously the House rejected. The proceedings of Parliament over this question of protection against electrolytic action have never been accordant. Variable decisions have been given by Committees—in most cases where favourable to the appellants for greater protection, only to be overridden by the influence of the Board of Trade. Has it been obtuseness, or the solicitation of interested parties, that has induced the Board to take the illogical view that any harm could come to electricity distributors from greater protection to pipe-owners when the venerable regulations of the Board are so perfect? It was hoped, with a change in the headship at the Board, that a broader view would be taken. But hope has had a set-back—events having made it plain that Progressivism, Socialism, and electricity supply are too intermingled for anything being done without insistent agitation. However, it is trusted that the Board of Trade will take note of Lord Newton's suggestion, and early act upon it. If they do, we hope that gas and water undertakings will be found with evidence marshalled as to the insidious action of electricity, its creeping effect on underground pipes, the insufficiency of present regulations, and the grave consequences attaching to escaping gas.

There have been in our columns in recent months several contributions to the literature of the subject, both from America and Germany. From America, we have had the interesting report presented to the American Gaslight Association by Mr. A. G. Glasgow, on behalf of a Committee appointed to consider the subject, and there have been various papers laid before technical organizations. From Germany comes a further report of the Electrolysis Commission of the German Association of Gas and Water Engineers. Reading these reports together, it is gathered that the systems for curbing the erratic wanderings of electric currents and preventing damage, are purely mitigatory; and in the American report it is pointed out that the German Commission have not once referred to the desirability and possibility of confining tramway currents by a completely insulated circuit. This the American Committee consider feasible, and advocate; and they further contend that electricity suppliers should be held responsible for all damage caused by their overt failure to control their own current. While the British regulations are directed towards the reduction of stray currents, the same Committee pronounce them "utterly insufficient in "character and degree." It is also gathered from the reports that present methods of diminishing injury to underground pipes are largely affected by soil and other local conditions. There is evidence, too, of electrical action slowly causing the weakening of pipes, and of another effect of electrolysis being to accelerate and intensify corrosion. The trouble is a progressive one. This is found in the American papers; and the German report supplies illustration. In Hamburg and Freiburg, conditions are found to be satisfactory; but at Strasburg and Erfurt serious injury has been done to pipes. But looking carefully into the report, there are evidences of what we have termed the creeping or slowly progressive action on pipes of stray electric currents. At Erfurt, the trams started in 1893.

In the early days, the return conductors must have been faulty; but they were improved about five years ago, though there are still defects in their arrangement and in some of the rail-joints. No doubt most of the injury done to the pipes took place before the returns were improved; *but failures are now cropping up in increasing numbers.* With an increase of water pressure, too, water-mains are beginning to burst.

At Leipzig, where attention has always been directed to the safe return of the tram current, and where, too, little harm has been done to the pipes until recently, *now lead pipes are beginning to fail.* . . . A good deal of trouble has recently been met with in the armour of the lighting cables. Generally, the insulation is at fault; some of the lighting current escaping to earth. It has also been found that the armour was conveying return current of appreciable magnitude from the tram service.

Lead pipes have already suffered, and iron pipes are beginning to corrode at Liegnitz.

At Danzig, iron pipes are beginning to suffer.

In technically cultured Germany, are they more backward than we in this country in their electrical systems? or are they beginning now to feel an unprecedented weakening of mains through the subtle and gradual work of the escaping current over several years? It is the future that has to be guarded against in the present. Although nothing much has been done since the decision of the House of Lords in 1904, let not that decision deaden action. Lord Newton has given a hint; continued agitation may consummate it. A Departmental Committee constituted of men of science may—provided it is not over-weighted with interested electricians—see things in a different light from the Board of Trade or the laymen of the Lords and Commons.

Be Watchful!

This is the advice of the Chairman of the Croydon Gas Company (Mr. Charles Hussey, J.P.) to the proprietors and the public regarding new gas promotions. The Companies which are to be shunned are those with small gas undertakings and heavy capitals, in rural districts, and in the prospectuses of which there is a conspicuous economy of information concerning past business and profits, but an abundance of particulars regarding companies of prosperous condition with populous districts and scope for business, and which have nothing whatever in common with the new comers. "Be watchful!" is sound advice. Watchfulness and prudence go together. Promoters of certain of the concerns that have been launched in recent times will not find the gas industry a lucrative field for their operations if an attitude of caution is taken by gas shareholders. Mr. Hussey's remarks on the subject are worth reading, as are also those of a proprietor, at the same meeting, who holds shares in a large number of gas undertakings, and whose waste paper has been supplemented by as many as twenty gas prospectuses in one day, due to his variety of holdings. This testimony indicates the completeness with which gas shareholders have been canvassed. There are plenty of long-standing good investments in the gas industry constantly on offer through developing business, without touching undertakings which show more certainty of failure than of prosperity.

We are extremely glad Chairmen and Directors of Gas Companies recognize that they are in a position to give a much-needed word of warning.

Formation of "Blue Salt" in Sulphate Making.

In the notice of the last annual report of the Chief Inspector under the Alkali Acts (Mr. R. Forbes Carpenter) which appeared in the "JOURNAL" for the 21st inst., reference was made to a memorandum furnished by Mr. S. E. Linder, his Assistant, in regard to the conditions affecting the formation of ferrocyanides in sulphate of ammonia saturators. In another column will be found the principal portions of the document. Two hypotheses have been advanced to explain the cause of the formation, and both agree in attributing the coloration of the sulphate to its contamination in the saturator by a minute quantity of an oxidizable ferrous ferrocyanide formed by interaction between ammonium ferrocyanide and salts of iron. The point on which they differ is as to the source of the former. M. Leriche considers that it is formed by interaction of ammonium cyanide, volatilized from the still, with ferrous oxide separated in the saturator during periods when the liquor has become neutral or alkaline through deficiency of acid. Others attribute the presence of ferrocyanide in the saturator solely to priming-over from the still of raw liquor containing it. At an early stage of Mr. Linder's investigation, the latter hypothesis afforded a very inadequate explanation of the observed facts. The explanation put forward by M. Leriche was therefore accepted as the working hypothesis in the investigation of which particulars are furnished in the memorandum. It indicates that the formation of "blue salt" proceeds in three stages: (1) The formation of ammonium ferrocyanide; (2) the formation of ferrous ferrocyanide; and (3) the oxidation of this substance to prussian blue. Mr. Linder gives full details of the experiments carried out, in conjunction with Mr. Sutton, at the East Greenwich station of the South Metropolitan Gas Company; and a valuable contribution on the subject is made by Mr. J. W. Young, the Sub-Inspector for the North of England district.

A Statutory Day of Rest.

On the Continent, one day of rest for labour out of seven is becoming compulsory. It is almost a coincidence that it was on July 17 last year that the Belgian Government enacted that employers should not engage their workpeople more than six days a week—with certain specified exceptions—the day of rest to be on Sunday, and that on July 13 this year the French Government should promulgate a law to similar effect. In France a weekly rest of not less than twenty-four consecutive hours must now be given to all employees and workpeople; and, as a general rule, such rest must be given on Sunday. In Belgium, as we announced in an editorial at the time, one of the exceptions are gas undertakings; and it is ordained in their case that the workmen shall not be employed for more than six-and-a-half days a week, or thirteen days in a fortnight. In the case of France, exemption is made regarding Sunday being the day of rest in a number of named employments, among which are lighting, water, and power distribution concerns. In these cases, without the special permission of the authorities, the weekly day of rest may be given to the staff in rotation.

In the Streets of London.

The electric light columns that have been presenting a very forlorn and derelict appearance in certains streets of the City, are now fast disappearing. The work of uprooting and removing the ponderous standards has been watched with unfeeling interest by such easily interested people as are to be found in the streets of London, always ready for something fresh to gape at. This removal will no doubt silence those electrical braggarts who have persisted in alluding to the change in the lighting of the streets referred to as nothing more than an experiment which would soon be brought to an end; and flame arcs would then rise triumphant in the City. The two clusters of flame arcs that the City of London Electric Light Company in their panic put up, have not proved the means of their redemption. All that the flame arcs have proved is that they are rich in illuminating power round about their columns; but are most economical in the illumination afforded beyond. Meanwhile, Oxford Street is suffering all the tortures of upheaval, through the operations of the Marylebone Borough Council in preparing for their unique scheme of lighting this important thoroughfare with widely spaced pairs of flame arcs—a system which was found expedient to enable the Electricity Department to get their costs down somewhat nearer to those of the Gas Company than were presented by the original estimate, but at the sacrifice of efficiency. A correspondent in the "Pall Mall Gazette" puts an amount of expression into his views on this Oxford Street scheme (it is sufficient to say he is a ratepayer). He says:

> This rotten scheme was rushed through the Council just before the vacation, and already the work is far advanced. Yet even now, it ought to be stopped at all cost. For it will not merely be a heavy additional burden on the rates, but a failure to boot. We have only to go into the St. George's, Hanover Square, district to realize that street lighting by electricity—on the arc system—is a ghastly failure, while gas-burners on ordinary lamp-posts, with Welsbach mantles, as at present in use in Marylebone, are a complete success even in the densest fogs.

Science of Illumination.

The proposition put forward by Mr. Leon Gaster three months ago for the formation of an Illuminating Engineering Society in this country (see June 12, p. 701) has as yet borne no response; and, though the benefits to be derived are unquestionable, it is feared that the interests of electricity and gas here are too antagonistic—mainly through the unfair competition accompanying municipal ownership of the former service—for the successful working of such a composite body as that represented by the Illuminating Engineering Society which has its headquarters in New York. While the acute competition continues—and there is no prospect of an end—the present waste that admittedly exists in illumination, and more especially in the multifarious methods of lighting our streets which give them such an incongruous appearance after nightfall, will continue, and can only be affected for the better by individual effort, and the present corporate agencies. It is a pity, but the facts are irresistible. We have received copies of the first four monthly transactions of the Illuminating Engineering Society of New York, which now also possesses New England and Chicago sections. Together the pamphlets contain 178 pages of printed matter, consisting of papers and discussions on both gas and electric lighting, outdoor and indoor. The variety is good; and the discussions excellent. The contributions dealing with gas lighting have been noticed from time to time in our columns. We have read certain of the other papers and debates with no small amount of interest; and one great value that can readily be seen in such a Society—apart from the dissemination of experiences, and the opportunity given for selection for application from those experiences—is that lighting engineers gain information as to the exact strength of the rivalry they have to meet, and the weak spots where attack should be commenced. This possibly is not regarding the Society from the highest level; but one's personal interests cannot be entirely banished in such connection, though we congratulate the American Society on the large amount of suppression in their debates.

A New Alkali Works Regulation Act.

In connection with the notices, in the last and present issues of the "JOURNAL," of the annual report of the Chief Inspector under the Alkali Acts, attention may be called to the fact that, after several attempts, a Bill was successfully passed through Parliament in the session lately closed to consolidate and amend the Acts of 1881 and 1892, under the provisions of which the report was made. It repeals the whole of these Acts, as well as the Local Government Board's Provisional Order Confirmation (Salt Works) Act, 1884. The new Act applies to 21 works, named in the first schedule; among them, of course, being gas liquor, sulphate and muriate of ammonia, and tar works. The owner of one of these is required by clause 7 to "use the best practicable means for preventing the escape of noxious or offensive gases by the exit flue of any apparatus used in any process carried on in the work, and for preventing the discharge, whether directly or indirectly, of such gases into the atmosphere, and for rendering such gases, where discharged, harmless and inoffensive." Should he fail to comply with this requirement, he is to be liable to a fine not exceeding, in the case of the first offence, £20, and in the case of every subsequent offence £50, with a further penalty of £5 for every day during which the offence continues. All the works scheduled are to be certified as having been registered; and the certificates in the case of works in which our readers are more particularly interested are to be charged with a stamp duty of £3. The Act comes into force on Jan. 1, 1907.

GAS STOCK AND SHARE MARKET.

(For Stock and Share List, see p. 602.)

THE Stock Exchange had a fair average week of business for the season of the year; but the tendency on the whole, putting out of consideration one or two lines which were being worked with special factors, was dull. The apprehension of tightness in the Money Market helped to keep Consols and the gilt-edged division at a disadvantage. Fluctuations occurred from time to time, and on Friday there was the usual realizing; but by the close a more relieved feeling prevailed. The Money Market was unsteady. The supply was ample at first; but soon a degree of stringency supervened, which, again, in its turn gave way to easier conditions by the close. Discount rates held very stiff almost throughout the week. Business in the Gas Market was about on an average scale for most days; but towards the end it died away to next to nothing. Although there were not many changes in quotations, they were enough to show that the buoyancy of the preceding week was well maintained, and that in our special market the operation of profit-snatching finds no abiding place. In Gaslight and Coke issues, the ordinary was moderately active and consistently firm. Prices at which transactions were marked ranged from 98½ to 99¼, at which latter figure stock repeatedly changed hands. The quotation was advanced half a point. The secured issues were quiet, excepting the maximum, which was dealt in to an unusual extent at from 88 to 88⅝. One transaction was marked in the preference at 109½ (a rise of 1 in the quotation), and the debenture was not dealt in. South Metopolitan was very quiet and steady. Three bargains were marked at 132 and one at 132½. Commercial was equally inactive. The 4 per cent. was done specially at 115¾, the 3½ per cent. at 112, and the debenture at 84½. In the Suburban and Provincial group, there was the average paucity of dealings—not for want of buyers, but for the absence of stock. Of course, all were firm, and one or two advanced. Brighton original changed hands at 236⅛, British at 41⅜ and 42, Lea Bridge at 124¾ (with an advance of one point in the quotation), and West Ham ordinary at 105½ and 106. Wandsworth and Putney "B" improved 2. On the local Exchange, Liverpool "B" made a similar advance—nearly touching a level 4 per cent. price for money. In the Continental Companies, Imperial was moderately active and very firm. Prices marked ranged from 184½ to 186; the greater part of the transactions being at the latter figure. European was more active than it had been for some time, and was done at from 24 5/16 to 24⅝ for the fully-paid. Union was not dealt in. Among the undertakings of the remoter world, Bombay was done at 6⅞ and 6 15/16, ditto new at 5⅛, Oriental specially at 151, Buenos Ayres at 12 9/16 and 12½, Primitiva ordinary at 7 1/16 and 7 1/32, ditto preference at 5⅜, ditto debenture at 97 and 97¼ (a rise of 1 in the quotation), River Plate at 13 and 12⅞ (a fall of ¼), and Monte Video at 11⅜ and 11½.

The closing prices are shown in our Stock and Share List on page 602.

ELECTRIC LIGHTING MEMORANDA.

Views from America on High Illuminating Power Sources Generally, and on Flame Arc Lamps in Particular—The Defects of Flame Arc Lamps—A Black Cloud in Marylebone—Present Results and Deferred Obligations.

IT is at times well to pause and ask ourselves, whether judgment on any particular matter is not clouded by prejudice. If when in this frame of mind, which indicates the passage of a current of generosity through it, the examination is satisfactory, then the additional consciousness of right that it gives will be of service. It is a further satisfaction when judgment is fortified by that of others at a distance, whose independence and qualifications entitle their views to respect. For this reason, interest is stimulated in ascertaining how the views of the experts of other countries on any special subject coincide with those in this country. During the short existence of the Illuminating Engineering Society of New York—in which gas and electric lighting engineers combine in technical discussion—there has been a large amount of light thrown as to the trend of views in the States in connection with street illumination; and we have been looking into what has transpired to see how far the attitude taken up in this column as to one or two matters, is confirmed by American experience. Arc electric lighting in the States has had a long and very substantial innings; but among electrical engineers there may now be found many converts to the belief—as is well expressed in a paper by Mr. Francis W. Willcox on "Electric Incandescent Lamps for Street Lighting"—that "the best system of street lighting is clearly that which gives an even light of sufficient intensity over all parts of the streets." If that fundamental truth were generally recognized by electricians here, we should get along with them very nicely. All forms of street lights—more particularly the flame arcs—give plenty of light near the lamps; and that light requires to be diffused. Hence the necessity in our streets for points of illumination of reasonable candle power, and at not too great distances apart. One electrician at the meeting at which Mr. Willcox's paper was discussed, is found relating how, in one of the towns lighted by his Company, the arc lamps created such a glare in their immediate vicinity that people complained that this only tended to intensify the gloom beyond their sphere of usefulness. The result in that town has been that 25-candle power electric incandescent lamps have (excepting a score of arcs) been installed throughout, notwithstanding bitter opposition, and such uncomplimentary but expressive descriptions as "tallow dips, lighting bugs, lemons on a stick," &c. We do not say that the authorities chose the best form of lower light units; 60 or 100 candle power incandescent gas-lights would have done better. But it illustrates one of the points that has been frequently advanced in the "Memoranda."

The high candle power of the flame arc lamps, and yet their limited sphere of illuminating usefulness, is one of the reasons why they have not obtained any strong foothold in America. This is gathered from the discussion of a paper by Mr. E. L. Elliott on the "Luminous Arc Lamp," as the flame arc is preferably known in the States. The author sings loudly in praise of the flame arc; but he cannot escape some mention of its detracting idiosyncrasies. He compares the efficiency of the lamp with that of the enclosed arc type, which appears (instead of the open arc) to be the one most favoured in the States. Never before has there been so much heard about spherical candle power and lower hemispherical candle powers as there has been since the advent of flame arcs; and taking these illuminating powers, the author makes out that the efficiency of the lamps is five times greater than that of the enclosed arc. But then, reading carefully, these peculiar admissions are discovered later in the paper: The *distribution* of the light from the lamps is practically the same as from the enclosed arc when used with opaline globes; and while the price of the chemical carbons is higher than that of the best pure carbons, the cost per candle power of the two types of lamp figures out *exactly the same*. He illustrates the paper with some curves of the relative distribution of the light from the flame and the enclosed arc lamps, which certainly do not show any superiority on the part of the flame arc lamp—in fact, in the text of the paper, he agrees that, for exterior lighting, a somewhat broader curve would be desirable. Spherical and hemispherical candle powers have come well to the aid of the electricians in showing large illuminating powers; and one of the speakers in the discussion—Mr. W. D'A. Ryan—hit off the conditions with an apt simile. He said there was something in this that appeared very much like "turning a headlight upside down, and concentrating all the light on one spot." "The tendency is," said the same speaker, "towards better lighting conditions; and one thing we are trying to do is to cut down the strong illumination, and save the eyes by spreading out the light. It stands to reason that you do not want a light that is strong underneath and weak beyond." This appears to be the general opinion of lighting engineers in the States—both electrical and gas; and they also think that the flame arc is one of those strong lights with poor distributive powers which have to be avoided, if alternations of intense light and dark shadows are not the perfection of street illumination. Owing to their intensity and unsteadiness, the lamps have to be placed well out of the field of vision and away from the surface to be illuminated; and as they can only be used in certain positions, What is the effect? One reply is given by Dr. Clayton H. Sharp, in the discussion: "The general effect of the illumination is ruined by the indiscriminate introduction of scattered units of such enormously high luminosity."

Concentrated high illuminating power is not the only drawback that the American lighting engineers have found in connection with the flame arc lamp. The efficiency of the white flame arc is not highly regarded by them. Mr. Elliott—the author of the paper—is of the opinion that the penetrating power of the yellow or orange coloured light is greater than is that of the blue and violet light of the open arc. But he does not make comparison with other methods of lighting. Putting on one side efficiency in respect of consumption and high candle power, he finds *per contra* the flame arc has these drawbacks: Owing to its greater length, the arc is naturally very sensitive to air currents; slag is also formed through the dropping of the fusible matter introduced into the carbons; the expense of the carbons is great; and perhaps the worst objection that can be urged against the lamp is the amount of attention it requires. Laconically, Mr. Ryan also sums up the view in the States as to the weak points of the flame arc: "High maintenance cost, due to expensive, short-lived electrodes; high intrinsic brilliancy; unsteadiness; fumes; and poor distribution." Mr. Alfonse Kaufman has evidently not much faith in the staying powers of the lamp; for he says it is "a novelty, something to attract attention, in which interest will last until the public tires of it." He does not think the life of the flame arc will ever approach that of the enclosed arc lamp. It is very useful to have the views of men of standing and independence in the lighting world of America, where electric lighting has—owing to the lower cost of electricity, and the higher cost of gas, than in this country—obtained a very considerable hold. Their views on the error of exceedingly high-power sources of light, and particularly of the flame arc lamp, are precisely those to which we have given expression and have consistently defended.

Poor Marylebone! The hapless and helpless ratepayers have our very deepest sympathy. They now know why the Borough Council just lately declined to let the lighting of Oxford Street slip out of their hands. To have adopted the cheapest and most rational system of lighting that street, and to obtain the best effect, would have been a loss of dignity (it matters little who has to pay for preserving that dignity); and the Council had the

knowledge while the Oxford Street lighting was under consideration that they would early—all too early for them—have to come before the ratepayers with a still greater humiliating confession than that their electricity undertaking could not, on fair grounds, compete with its rival. The confession is out before officially intended; and there is the irrepressible evidence, in black and white, that the Marylebone electricity undertaking represents one of the most—is it not the most?—gigantic and appalling blunders that has ever disgraced the annals of local government. The report and accounts of the Department have been printed; and the "Marylebone Mercury and West London Gazette," having obtained possession of a copy, have no doubt spread dismay among the ratepayers by a very plain disclosure, presented with a piquancy that cannot fail to drive home the facts, as to the bad character of the particular white elephant that the Borough Council have seen fit to acquire in their name, and upon which they have been spending, over and above the heavy purchase price, money by thousands upon thousands. It is a sorry revelation, and will make the ratepayers tremble for their future. The capital of the concern is now roundly £2,000,000; but at the 31st of March last it was £1,755,405. It is necessary to bear these figures in mind because they show the extraordinarily rapid growth of capital; and this growth will have a weighty bearing upon future accounts. The balance upon revenue account is only £12,442; and after wiping out an adverse balance of £5143, there remains in hand a sum of £7298, which—this must surely be a piece of sardonic humour on their part—the Committee submit "with much satisfaction."

Now let us see what grounds there are for satisfaction of any degree. The net revenue account is credited with a sum of £22,753 received from the Metropolitan Electric Supply Company under a working agreement now concluded, and so no entry of the kind will recur. The interest on 1¾ millions of capital has to be met; and it amounts to nearly £70,000. Under the three years' deferment of the sinking fund which the County Council allowed, the proportion of sinking fund for the three years is shunted on to the years to come; and a year hence commencing provision will have to be made for the first instalment of repayment. No allowance is made in these accounts for repairs and renewals, or for depreciation. These briefly are the burdens that the Electricity Department are for the present keeping safely in store for the ratepayers, to be drawn out portion by portion until the full load is safely on their backs. The present accounts exhibit a really deplorable condition; but with forced optimism, the Committee assert that—in view of subsequent economies, and more favourable conditions—they have every reason to believe that the undertaking is capable of achieving successful financial results after allowing for an average reduction of price to the consumers, even when the repayment of capital charges has to be made. One direction in which the Council look for improvements is to the new generating-station; but they cannot get much more help in that direction than they have already secured, seeing that they obtained the benefit of it early in August last year, and so (as our local contemporary points out) had the advantage of the new plant during the best eight months' trading of the financial year. Moreover, it may be taken that there are already connected the best customers that the concern will ever get; and correspondence is informative of many shops returning to incandescent gas lighting. There is another thing that arrests the attention of our contemporary. It is, of course, a matter of common knowledge to those who study these matters, that the percentage of electricity unaccounted for in connection with electricity undertakings always appears to be an ugly proportion of the whole; and yet owners of underground pipes cannot get any protection against this roving current. In this case, the number of units of electricity generated last year by Marylebone was 5,632,438. Of this quantity, 3,682,841 units were sold, 1,009,960 units were used on the works, and 935,285 units were unaccounted for. These figures respectively represent of the current generated 65 per cent. sold, 18 per cent. used on the works, and 17 per cent. lost—that is to say, 35 per cent. was used on the works or lost. The "Mercury" critic is probably not aware of the fact that electrical driving is the vogue at this station. However, if all local papers would look into the municipal trading accounts with the acumen displayed by our contemporary, the members of our urban authorities would find it incumbent upon them to realize—as many of them certainly do not now—the fiduciary character of their positions, and their moral obligations and responsibility.

At a recent meeting of the Dunedin City Council, some important matters in connection with the city gas-works were considered in committee. On the Council resuming, the following resolutions, adopted in committee, were confirmed. "That Mr. Hungerford, Assistant-Engineer at the Christchurch Gas-Works, be appointed Gas-Works Manager, at a salary at the rate of £300 per annum." "That Mr. Thos. Dow be appointed Gas-Works, Foreman, to act directly under instructions of the Works Manager, until such time as a permanent appointment is made." Mr. Robert English, the Consulting Engineer, submitted a report on the gas-works extensions, which are to be proceeded with at once at an estimated cost of £55,000, part of which amount will be paid from revenue. Plans and specifications of the works are being proceeded with.

INVERTED GAS-LAMPS FOR LIGHTING EDINBURGH STREETS.

The "Star" Burner Adopted.

SINCE the article that Mr. W. R. Herring contributed to the "JOURNAL" for April 24 last (at the request of the Editor) on the photometric tests and other trials that had been made preliminary to the proposed application of the inverted incandescent gas-burner to the lighting of Edinburgh streets, there has been an ardent desire on the part of many gas engineers and makers of inverted burners to learn upon which one, out of the numerous types tested—comprising, in fact, all well-known burners—the Lighting Committee would finally determine under the guidance of their advisers. To Mr. G. A. D. Mackay, the Inspector of Lighting, and to the painstaking and comprehensive investigations conducted by Mr. Herring and his assistants in the photometer-room, with durability and efficiency tests in streets and other exposed outdoor situations, belong the honour of bringing to a head a scheme that places Edinburgh in a pioneer position in the application of inverted incandescent gas-burners to street illumination, and will give to it a uniqueness among cities in its lighting arrangements. The Star Inverted Incandescent Burner Company, Limited, have now had from the Lighting Department of the Corporation an intimation to the effect that they have, as the result of the repeated testing experiments with inverted burners, adopted the Star burner for incandescent street lighting as being—the information to hand runs—"the most effective one available." Following upon this, the Company have received from the Lighting Department extensive orders for burners, mantles, &c.

The importance of this decision to the Star Company cannot be gainsaid; its importance to Edinburgh—owing to the extent of the change that is about to be made, involving thousands of burners—in the vast improvement there will be in the lighting of the streets, is great; and its importance from the technical point of view, as an innovation and, in fact, revolution in street illumination, is such that it will arrest wide-spread attention. On the completion of the scheme, the capital of Scotland will be the Mecca of many a lighting authority anxious to effect an economical improvement in their street lighting. Caution and economy have been the outstanding factors in the delay there has been in bringing about the complete transformation in the lighting arrangements of the city, apart from the comparatively limited application of electricity and upright incandescent gas-burners; and it is, considering those factors of caution and economy, a matter of supreme gratification that a system of gas lighting, and not of electricity, has been finally preferred. The Corporation wanted the best system for the lighting of their streets in which the illumination had not already been raised above that afforded by flat-flame gas-burners; but, with their rich gas, they were in no particular hurry. In the second place, they did not wish to exceed—but if at all, only to a limited extent—the consumption of the flat-flame burners, which are rated at 2 cubic feet per hour. Then came the prolonged tests of inverted incandescent burners, commencing in 1904, the results of which were recounted in the instructive article by Mr. Herring last April. Inverted burners were chosen for these trials both on account of their downward and horizontal illumination and their capacity for giving a high illuminating power for a low consumption of gas. "The smallest type of upright incandescent burner," said Mr. Herring in his article, "that could be recommended was 3 cubic feet per hour," which would have added "considerably to the cost of public lighting as distinct from England, where the introduction of ordinary incandescent burners reduced the consumption." Early experiments showed a "very marked superiority in both the appearance and effective illumination yielded by a lantern fitted with the inverted burner and the same lantern fitted with an upright burner consuming more gas;" and this quickly convinced those concerned "that the future, so far as Edinburgh was concerned, lay in the adoption of the inverted burner." That public lighting future has now been settled by the communication received by the Star Company.

The burner that has been adopted is that known as the Star No. 2; but its consumption of gas under ordinary circumstances is 2½ cubic feet per hour. This was even more than the Lighting Committee cared to sanction, having regard to the 2 cubic feet consumption of the flat-flame burners. The Company are therefore providing a very accurately made nipple for the burners designed to consume 2¼ cubic feet per hour of Edinburgh gas. In addition to the efficiency of the "Star" burner as disclosed under Edinburgh conditions, cheapness of renewals has also been taken into consideration in arriving at a decision.

Considering the lengthy and critical trials to which the various inverted burners were put, there is every reason for heartily congratulating the Star Company upon the success of their burners in satisfying the strict requirements of the Edinburgh authorities—in respect of economy, efficiency, and reliability—under the conditions for which they are destined.

To cause paint to adhere firmly to galvanized iron, the United States Government have recently adopted specifications compelling the use of vinegar for washing the surface preparatory to painting. This roughens the surface and facilitates adherence.

MUNICIPAL OWNERSHIP CONSIDERATIONS.

THERE has not of recent times been any lack of literature on the vexed question of the relative advantages of municipal and private ownership, though it may be admitted that the amount of consideration given to the subject is not greater than the importance of it justifies. The matter is one in which everybody is more or less closely interested—as ratepayers, councillors, or shareholders in trading concerns. It is within the knowledge of "JOURNAL" readers that an American Commission have lately been in this country making exhaustive inquiries as to the results of present-day municipal policy; and the interest taken in the matter by our cousins across the Atlantic is still further emphasized by investigations which have been carried out during the past few years by Mr. Hugo Richard Meyer, for some time Assistant Professor of Political Economy in the University of Chicago. Mr. Meyer is incorporating the results of his inquiries in four books, which will give the outcome of his examination of the actual working, in important instances, of the public regulation and the Government ownership and operation of the so-called "public service industries."

The second volume of the series, which has lately been published,* deals with tramways, electric lighting matters, &c., in Great Britain. In order to explain the conditions under which Parliament passed the Electric Lighting Act of 1882, the author refers briefly to the purchase of company gas plants by municipalities. In this chapter, Mr. Meyer shows that the policy of acquiring these undertakings has been much more marked at some periods than at others; and he remarks that the suspension of purchases by the municipalities in the period from 1879 to 1892 was due to the fear of the electric light as a competitor of gas. After the latter year, however, this fear disappeared; and the policy of acquiring gas plants was keenly resumed. In compiling his facts and figures, the author has naturally had recourse to various publications; and he makes free acknowledgment of his indebtedness to the "JOURNAL" and other sources. After considering the policy adopted in this country with respect to electricity, there is a chapter entitled "Municipalities *v.* Wage-Earners," and the ground covered by this will be understood from Mr. Meyer's remark that "some indication of the extent to which the demand for labour has been restricted in Great Britain by the practice and the spirit of municipal ownership, is to be obtained by comparing the number of wage-earners in the electrical industries of Great Britain and of the United States." After a chapter on "Municipal Employees"—in which their political power is dwelt upon—we come to the author's conclusions regarding "public service industries," which make use of the streets. Comparing the United States with Great Britain, Mr. Meyer remarks: "After the British cities had paralyzed individual initiative and private adventure, they declined themselves to step in and fill the void created. Therefore the task of establishing successively the horse street railway industry, the electric lighting industry, the telephone industry, and the electric street railway industry was left to the United States, the only country which, in the pregnant period from 1870 to 1900, granted to public service companies charters that were sufficiently liberal to induce such companies to assume the great risks and losses which are an unavoidable incident to the establishment and the subsequent development of new industries. . . . The English and the German municipalities contributed nothing to the development of those industries." Mr. Meyer is a believer in the freedom of individual action which he says exists in the United States; and he argues that only as a last resort—as "the last means of escape from ills that can no longer be borne"—should they have recourse to extending the functions of the state or the city.

* "Municipal Ownership in Great Britain," by Hugo R. Meyer, of Chicago. Macmillan and Co., Limited. London: 1906.

Professor Thompson's British Association Lecture.

In the course of the abstract of Professor Silvanus Thompson's British Association lecture, on "The Manufacture of Light," which appeared in the "JOURNAL" on the 14th inst. (p. 449), it was mentioned that the lecture was illustrated by means of various lighting appliances fitted upon a ten-light rail in front of the audience. We now learn that one of these was a lamp on the improved Scott-Snell system, which had been specially sent to York by Messrs. Anderson and Co., Limited, with an assistant, to aid the lecturer in his demonstrations. It was the only high-power gas-lamp of which any photograph was shown on the screen; and it was exhibited as the "latest form of gas-lamp." Views of gas lighting by high pressure at the Mansion House and the Royal Exchange were also shown; and reference was made to the installations in Aldwych, in Whitehall, and at Victoria Station. At the close of the lecture, Professor Thompson included the above-mentioned firm among those who, he said, deserved the thanks of the audience and of himself for their courtesy in sending apparatus to be exhibited. In supplying an omission from the abstract of the lecture published by us, which was based on that furnished to the Press, we may point out that the table given, which mentions only the "Millennium" high-pressure gas light, was taken from Herr Wedding's Berlin tests.

A PRIZE ESSAY ON GAS v. ELECTRIC LIGHTING.

(*Concluded from p.* 503.)

THERE is a large amount of nonsense in the essay on the subject of the lighting powers and renewals of incandescent gas-lamps; and we challenge Mr. White for photometrical proof that, when the mean average candle power of an incandescent gas-burner is taken during the life of the mantle, it will be found that it is little more than that of a 16-candle power incandescent electric lamp, supplementing which statement he magnanimously says: "In order to give the full advantage to the gas-burner, the average candle power is taken at 20." Then Mr. White allows four mantles per 1000 hours for renewals, and 6d. for depreciation of the burner. It would be a careless household that required four mantles per burner per 1000 hours; and, as decent ordinary incandescent burners can be obtained for 1s., with the essayist's allowance for depreciation, a new burner could be applied every 2000 hours. We can put hands on burners of this description that have been in use for years. Regarding renewals for incandescent electric lamps, the happy recipient of the £5 thinks that 1⅓ lamps at 1s. per 1000 hours will be sufficient. With electricity at 4d., Mr. Wild, as previously shown, calculates 450 hours as the scrapping point, which would mean about 2·2 lamps for renewals per 1000 hours. Mr. Fedden, the Chief Electrical Engineer of the Sheffield Corporation, stated in a recently published paper, that a fair average renewal for electric lamps in private houses would be three a year; and the price that has to be paid for these over the counter in London is 1s. 1d. or 1s. 2d. Therefore for each 16-candle power point, 3s. 6d. ought to be spent on renewals per annum, as against an average (say) of three mantles for each ordinary incandescent gas-burner in a house, giving a light, with a periodical cleaning of the burner, of not less than 60 candles. About four (nominal) 16-candle power carbon filament lamps are required to give the illumination of one 3½ cubic feet incandescent gas-burner; so that the 3s. 6d. per point per annum for the renewal of incandescent electric lamps must be multiplied by four to get anything like equality.

But it is in the table accompanying the essay that Mr. White gives most prominence to his most erratic calculations. His professed belief in the immutability of the carbon filament electric lamp is again seen in the very first column, where he assumes a total of 16,000-candle power for 1000 hours; and a cost of 1s. 5½d. per 1000 candles per hour. However, as Mr. Leon Gaster puts the cost per candle for 1000 hours at 1s. 2·11d., we will not quarrel with Mr. White over it; more especially as he shows that a flat-flame gas-burner will return the same duty for 1s. 3d., or 2¼d. less. Then Mr. White takes the Nernst lamp at 100-candle power, and the consumption of electricity at 100 watts per hour. We have not yet been able to make the acquaintance of a 100-candle power Nernst lamp, giving an efficiency of a candle per watt. Mr. Lancelot Wild gives for a ¼-ampere Nernst lamp, with globe, a mean hemispherical illuminating power of 29 candles, and the consumption of electricity at 1·76 watts per mean hemispherical candle power; and towards the end of last year, we read in the "Electrical Review:" "For each 4 feet incandescent gas mantle, we would use a ½-ampere Nernst lamp, which will give about 70-candle power when new. This lamp also falls off in candle power." Mr. Leon Gaster states that the consumption of the Nernst lamp varies between 0·9 and 1·9 watts per candle. Who are we to believe—well-known men like Mr. Wild and Mr. Gaster, or the unknown Mr. George White? Taking the generous liberal illuminating power of 100 candles as being maintainable on 100 watts per hour, with two renewals at 2s. each in 1000 hours, the prize essayist makes out that the cost of 1000-candle power per hour by the Nernst lamp will be only 4½d. Mr. Leon Gaster, in his Society of Arts paper, puts the cost at 8·82d. per 1000 hours per candle power. Sir William Preece writes regarding the Nernst lamp: "They are somewhat deficient in reliability and durability, and are sensitive to changes in voltage." Mr. White does not bring into comparison the ordinary arc lamp, because, we think it safe to say, he does not dare to. He skips everything between the Nernst lamp and the flame arc; and in this connection refers to a 2500-candle power flame arc lamp, consuming 500 watts per hour! Now what is the use of running wild in this way? The makers themselves, with all their friendly elasticity for their own productions, do not speak of any lamp that they recommend for ordinary use as being of 2500-candle power. The lamps they do recommend are described as being of from 1200 to 1500 candles; but electrical engineers would not be prepared to guarantee, under a penalty, the constancy of any such figures. As to the 500 watts per hour for 2500-candle power, electrical engineers will smile over that. At a meeting of the Institution of Electrical Engineers a few months ago, Mr. E. E. Hoadley, the Electrical Engineer of Maidstone, said: "The wattage consumption of existing flame arc lamps—viz., 800—was far too high for general use in the streets of the smaller towns." There are, of course, flame arc lamps requiring much less wattage than that; and it may be taken that the 500 watts is fairly near the accepted consumption per 1000 candle-power-hour. With the fundamental figures vitiated in this manner, it is useless paying any heed to Mr. White's 1d. per 1000 candle-power-hour for flame arcs, including renewals and the expensive short-duration carbons. Nor is there anything fresh to say on the question of flame arcs to supplement the articles in the "JOURNAL" for

May 22 and 29 last, and the subsequent occasional references made in our "Electric Lighting Memoranda." Positions where "2500-candle power" lamps can be used are very limited; and lighting engineers who know their business prefer centres of lower power, at fairly frequent intervals, so as to get uniform lighting.

Passing from electricity to gas, mention has already been made of the flat-flame gas-burner, and to the fact that the cost, in Mr. White's opinion, per 1000-candle power per hour, is less than for the 16-candle incandescent electric lamp. Coming to the incandescent gas-burner, if the prize essayist wishes to be taken seriously, then we accuse him of deliberate dishonesty in taking an incandescent gas-burner, consuming 3½ cubic feet of gas per hour, as being of only 20-candle power. Anyone can get 25 candles with a bijou inverted burner, consuming 1 cubic foot of gas per hour; but we will keep to the 3½ cubic feet upright type. Mr. Swinburne, whose name is better known in the lighting world than Mr. George White's, allows 18 candles per cubic foot of gas for ordinary incandescent burners; and any fair-minded electrician who is also a photometrician, will be prepared to say that the "Electrical Contractor" has done an unjust thing in accepting this essay as one that gives "fair play to both sides of the question." Consuming 3½ cubic feet of gas in an ordinary incandescent burner, and assuming an illuminating power of only 20 candles, Mr. White computes that this method of lighting would cost 7½d. per 1000-candle power per hour. Mr. Leon Gaster gives 3·17d. per 1000 hours per candle power; and Professor Silvanus Thompson says that 12,500 candle-hours can be obtained for 2s. So, again, we ask, Who is to be believed—Mr. White, Mr. Swinburne, Mr. Gaster, or Professor Silvanus Thompson? The same ridiculous lines are taken by Mr. White in connection with intensified gas lighting; and for a consumption of 20 cubic feet of gas he only concedes an illuminating power of 400 candles, which is merely an efficiency of 20 candles per cubic foot, to gain which it would be folly to go to the trouble of raising the gas pressure, seeing that Mr. Swinburne grants an efficiency, to ordinary low-pressure incandescent gas-burners, of 18 candles per cubic foot. Yet on Mr. White's low estimate of efficiency, the cost per 1000-candle power per hour only comes to 2d. But the fact is that candle powers approaching double what Mr. White asserts can be obtained—or to be modest (say) 30 to 35 candles—per cubic foot under high-pressure systems; and gas is usually supplied for high-pressure lighting in streets at considerably less than 3s. per 1000 cubic feet. There is the authority of Professor Silvanus Thompson for saying that, by one high-pressure system—the Millennium—25,494 candle-hours can be realized for 2s., which is less than 1d. per 1000 candle-hours, and compares with Mr. White's 1d. per 1000-candle power for one hour for the absurdly rated 2500-candle flame arc lamp, consuming only 500 watts.

We do not think electricians will be prepared to endorse the "Electrical Contractor's" action in putting forward, as an essay worthy of a prize and of public acceptance, a composition containing so many palpable misstatements. We are left wondering as to what was the test, other than "restraint," that the Editor adopted in adjudicating upon the essays.

There is a page in the "Bazaar, Exchange, and Mart," in which articles dealing with general matters are usually fairly treated. But one by the Editor on the cost of "Electricity *v.* Gas for Indoor Lighting," in reply to an inquiry by a correspondent, can hardly be so described. We should like to point out to the Editor that seeing that a 3½ cubic feet incandescent gas-burner will give 60 candles illuminating power, 24 of them would not be required to do the work of 24 16-candle power electric lamps. The 24 incandescent gas-lamps would give 1440 candles, against 384 candles for the incandescent electric lamp. This great difference has to be taken into account. The other points that the Editor refers to are covered by the preceding criticism of a "prize" essay on the subject. Perhaps he will reconsider his statement that "in the case of fire risks also, electric lighting is infinitely safer than gas lighting."

GAS-TURBINE PROSPECTS.

Of all the problems engaging attention in the realm of dynamic engineering at the present time, perhaps the most interesting is that of the gas-turbine, and therefore the frequency of the references before engineering societies and in the technical press. Scientific men, inventors, and engineers are devoting themselves to evolving a practicable and economical machine; but great difficulties obsess the problem. In the current issue of the "Engineering Magazine," there are two articles bearing upon the question—the first, by Dr. C. E. Lucke, and the second by Mr. C. M. Garland. The last-named author, however, only recounts the results of his studies in one aspect of the many-sided problem. He describes a constant pressure generator that he designed for, and used in, his experiments on obtaining the fluid with which to drive the gas-turbine. So far as the practical operation of the generator is concerned, within the range of pressure and temperature used by the investigator, it appears that no serious difficulties presented themselves. Such troubles as there were, it is believed, have been effectually eliminated. But owing to these troubles, no dependable results as to efficiency have yet been obtained. But the indications are, considering the restricted size of the apparatus, that the efficiency is high—at any rate, they are such as to be a stimulus to further investigation. The efficiency has therefore yet to be determined; and then will follow consideration of the form of turbine best adapted to be used with this type of generator.

We are, however, afraid that the generation of the driving medium is the least of the difficulties surrounding the gas-turbine problem; and, turning to Dr. Lucke's paper, hopes obtain little to buoy them, from the conclusions of the review that this pioneer worker makes, as to any likelihood of immediate success. While scientifically there is nothing impossible in the conversion of heat energy into work by a gas-turbine, the fact cannot be denied that there is not to-day any tangible result in the form of a working machine. Gas-turbines, as Dr. Lucke points out, have been made which will run; but that is not sufficient. To receive any consideration whatever as useful machines, they must somewhere nearly approach the steam-engine or the gas-engine in economy, or show promise of so doing, and must, at the same time, approach the steam or the gas engine in reliability, life, space occupied, and other commercially valuable features. It is a matter of some regret to Dr. Lucke that by far the most of the experimental results along these lines have been suppressed. It is regrettable, because it would save an immense amount of repetition work by various investigators—involving much time and labour, and great expense—and an openness as to the knowledge gained would undoubtedly accelerate the time of the success that it is believed by the most devoted students of the problem will be eventually achieved. But how is concealment to be avoided? Every worker in the field is so because of his expectation of an ultimate reward; and the disclosure of the results of his work might be to his own disadvantage and to the enrichment of others. There is even suppression as to decided failures, owing either to coyness in facing a fancied humiliation, or to fear that others will detect the point of failure, and derive the full benefit of the past work, through their own more fortunate discovery. Of course, there is human, but very pardonable, selfishness in this.

In an earlier paper on this subject, Dr. Lucke pointed out one of the difficulties of executing a practical gas-turbine—free expansion by means of the nozzle; and he regards this as the basic difficulty. It has been found, by experimenting with nozzles, that the temperature drop in the nozzles between the place of no velocity and high pressure, and the place of maximum velocity and low pressure is very small, and averages about 12 per cent. of what is theoretically possible, and of that which would be attained by a piston expansion of the same gases. Since that time, the temperature drop in an actual turbine has been measured and compared with the theoretical pressure drop; and the performance of the turbine operating with air has also been measured. Dr. Lucke traverses at length his investigations in this direction, with the result that he believes they most emphatically confirm his previous experiments and conclusion—that the temperature drop in free expansion with such nozzles as have been used, indicates a very small conversion of heat into work. Stated otherwise, free expansion in such nozzles as these is very inefficient as a means for transforming that into work. Dr. Lucke's inquiries among men who have worked with compressed air, and with jets and nozzles, have failed in every case to develop a single instance where there occurs a substantial cooling of perfect gases by free expansion. One man is probably better fitted than any other, by reason of his life-work, to express an opinion—Dr. Ernst Körting, the inventor for many years of jet apparatus of all sorts, and of gas engines and producers. After a life spent in jet and gas engine research, Dr. Körting sets it down as a fact that he has never noted a single case of efficient expansion of gases, as shown by temperature drops.

With the object of obtaining the views of other engineers upon this gas-turbine problem, Dr. Lucke addressed a number of questions to men whose opinions appeared to be desirable. But not half the men to whom the questions were forwarded replied; and, curiously, most of the gas-engine makers were in this class. Their replies are varied, and individual judgments are widely opposed. They all more or less show the problem to be a complex one; but optimism and pessimism appear to be pretty well equally sprinkled through them. This, however, is how Dr. Lucke himself concludes: "After a review of the whole situation, it appears that theoretically there is nothing impossible in the problem, and such difficulties as exist are purely practical, and of no mean order of magnitude. So great are the difficulties encountered by those who have experimented, and so great are those that are foreseen by practical men whose lives are devoted to overcoming difficulties, that those who are engaged in trying to perfect such a machine as this are warned of the certainty that their efforts will be fruitless for a long time at least, that much money will be spent with no tangible results, and that the practical gas-turbine is a long way off." We can only hope, though the hope confessedly has a poor foundation, that Dr. Lucke will be found to have erred in his prognostication.

Mr. Charles Henry Crane, of the Lowlands, Tettenhall, Wolverhampton, formerly head of the ironfoundry business now carried on by the Crane Ironfoundry Company, Limited, Chairman of the Wolverhampton Gas Company, and a Director of the Wellingborough Iron Company, who died on the 26th of May last, aged 76, left estate amounting to upwards of £138,221.

MANCHESTER INSTITUTION EXCURSION.

The Excursion Meeting to Ilkley on Saturday must be reckoned among the pleasantest and most successful of similar gatherings of the Manchester Institution during recent years. Nothing in the way of business was attempted; the whole day being given up to sight-seeing in the beautiful surroundings of the world-renowned district of Yorkshire through which runs the River Wharfe, and where Bolton Woods and the "Strid" attract all the year round such crowds of excursionists.

The experiment started last year, of inviting ladies to the August excursion of the Institution, proving so successful that the Committee determined to try again; and there is no doubt there will now be no going-back in this matter. On Saturday, close upon a hundred members and visitors took part in the trip. Reaching Ilkley about 11 o'clock, the gas-works of the Urban District Council were first visited by the male portion of the party; and some half-hour was devoted to going through them, under the direction of the Manager (Mr. W. Everitt). The main centre of interest was naturally the Everitt "Tar-Separator," which is still doing effective work at Ilkley and many other places—nearly the last place at which it has been put in operation being Widnes. Mr. Carr promises some details of results there, so soon as he has had an opportunity of fully testing the capabilities of the apparatus. The construction and working of the separator formed the subject of a paper read by Mr. Everitt before the Institution in 1904 (see "JOURNAL," Vol. LXXXVIII., p. 700).

A short drive from the works brought the members to the Wells House Hydro, to which the ladies had already been conducted by Mrs. Everitt. Here a welcome luncheon was provided, on the invitation of the Urban District Council. It was served in the Winter Garden of the establishment; and the proceedings were enlivened—some may be inclined to think all too noisily—by music discoursed by the (quoting the programme) "Ilkley Urban D. C. Military Band." If only the band had arranged to "play on the lawn during lunch," as mentioned in the programme, instead of in the glass-covered building in which the meal was served, or else had moderated their playing to suit the place, the comfort of the party would have been immensely increased. This, however, by the way. At the close of the lunch, the President (Mr. J. H. Brearley, of Longwood), in felicitous terms, proposed the health of "The Chairman and Other Members of the District Council," dwelling on the extreme kindness and courtesy shown by one and all in the making of arrangements for the day's outing, and providing so excellent a prelude to the drive, to which all were so looking forward that afternoon. Short but appropriate replies were made by Mr. Middlebrook, the Chairman of the District Council, and by Mr. Benson, the Chairman of the Gas Committee.

After a photo of the party had been taken in front of the hotel, coaches were requisitioned for the drive, *viâ* Nessfield, to Bolton Woods (where afternoon tea was served at the Strid Cottage), and thence on foot to the Strid. Time did not permit of more than a passing glance at Bolton Abbey on the drive back to Ilkley, which was reached in time for high-tea to be enjoyed at Lister's Arms Hotel before the scheduled trains were due to start for Manchester, Leeds, and Bradford, to take the party to their several destinations.

Thanks to the pleasant weather conditions—a bright day with a fairly brisk breeze—and to the excellence of the arrangements mapped out for the day by the Hon. Secretary of the Institution (Mr. H. Kendrick, of Stretford), the excursion was on all hands voted an unequivocal success. The help, too, that Mr. and Mrs. Everitt and Mrs. Lupton rendered in entertaining the ladies of the party should not be overlooked in this connection.

ITALIAN GAS SOCIETY'S ANNUAL MEETING.

THIS year the annual meeting of Italian gas engineers and managers will partake of something of an international character—although we think that the term "international" is in danger of being somewhat too frequently used. However, the justification for its application to next month's meeting of the Italian Gas Society is at least two-fold. Firstly, as we announced in our issue of Oct. 24 of last year, there are prizes offered for international competition on selected gas subjects; and we subsequently recorded that three papers had been sent in—one dealing with carbonizing in horizontal, inclined, and vertical retorts; another (a British paper) on tar extraction and gas condensation; and a third, on the subject of electrolysis of gas-mains. It is rather disappointing, perhaps, that, as three prizes were offered of the value of £20, £30, and £40, more papers were not submitted; but, anyhow, this competition forms one claim for the meeting to be considered international. In the second place, there will certainly be present representatives of at least some Gas Societies of other countries; for we understand that the Société Technique du Gaz en France will be officially represented, also that members of the Swiss Association (who will be holding their annual meeting at Lugano on Sept. 9) will go on to, and be present at, the Italian meeting. This, as we have previously announced, will be at Milan; and the International Exhibition that is being held there to commemorate the opening of the Simplon Tunnel Railway gives a further touch of internationality to the Milan gas meeting.

The President for the year is M. Lacombe, who was recently appointed Manager of the Milan gas undertaking of the Cie. L'Union des Gaz. He will preside at the preliminary meeting, which is to be held on Monday, Sept. 10, in the Salone del Pulvinare in the Exhibition grounds. The following day, when what is called the "official" international meeting takes place, the Pro-Syndic of Milan, Sig. L'On. Avv. Della Porta, has consented to take the chair. This second meeting will be held in a larger building of the exhibition, and is called the Salone della Previdenza. The usual programme will be gone through at the ordinary meeting—the approval of the minutes of last year's meeting, the financial statement, installing the President, introduction of new members, and so forth. Certain proposed Bills will be discussed relating to work on holidays, labour contracts, and the periodical verifying of meters. This last subject we referred to in the "JOURNAL" for March 13 (p. 713). The three papers submitted for the international competition will be voted upon by the general meeting.

Certainly, not one of the least interesting items on the programme will be the visit to the works of the Cie. L'Union des Gaz at Milan, which will be inspected on Tuesday afternoon, Sept. 11. The Italian Gas Society's annual dinner will be held on the evening of the same day; and on Wednesday, Sept. 12, the gathering will be brought to an end after a trip on the Italian lakes, which has been offered by the Cie. L'Union des Gaz.

Though the programme, apart from the three competitive papers, does not appear to promise much in a technical sense, we have no doubt the meeting will prove a profitable and an attractive one.

FORMATION OF FERROCYANIDES IN SULPHATE OF AMMONIA SATURATORS.

In the notice of the annual report of the Chief Inspector under the Alkali Acts (Mr. R. Forbes Carpenter) which appeared in the "JOURNAL" last week, reference was made to a memorandum on the above subject by Mr. Carpenter's Assistant (Mr. S. E. Linder, B.Sc.). The investigations recorded are of so much interest that we make the following extracts from it.

Dealing first with the conditions that determine the formation of "blue salt" in the distillation of ammoniacal liquor containing cyanogen compounds, Mr. Linder says they are obscure, and that no certain data exist to guide the chemist in his search for a reliable working hypothesis sufficiently comprehensive to embrace all the recorded facts. Two hypotheses have been advanced in recent years. Both are in agreement in attributing the colouration of the sulphate to its contamination in the saturator by a minute quantity of an oxidizable ferrous ferrocyanide formed by interaction between ammonium ferrocyanide and salts of iron; but they differ with respect to the source of origin assigned to the ammonium ferrocyanide. Hypothesis A—that of M. Leriche ("Revue de Physique et de Chimie," July, 1901)—represents the ammonium ferrocyanide as formed by the interaction of ammonium cyanide (or hydrocyanic acid), volatilized from the still, with ferrous oxide (or sulphide) separated in the saturator during periods when the liquor has become neutral or alkaline through deficiency of acid or some other cause. Those who favour Hypothesis B reject this explanation, and attribute the presence of ferrocyanide in the saturator solely to priming over of raw gas liquor containing it from the still. Apart from the scientific interest of the subject, the difference between the two points of view is of great practical importance, if a remedy be sought for the evil in any given case. If priming be the sole cause of "blue salt," anti-priming devices should provide a remedy; if, on the other hand, the formation of ammonium ferrocyanide in the saturator is due to reactions between volatile cyanide from the still and salts of iron introduced with the acid, a remedy must be sought in altered conditions of working.

Mr. Linder explained that the present investigation was undertaken to compare the merits of the two hypotheses advanced, and to ascertain by laboratory research such additional data as were needed to test the conclusions arrived at. At an early stage in the inquiry, it was seen that Hypothesis B (priming) afforded a very inadequate explanation of the observed facts. Ammonium ferrocyanide is rarely present in conspicuous amount in ammoniacal liquors from British sources; it has been shown to be absent from the liquors distilled in certain works where "blue salt" has been most complained of—*i.e.*, coke-oven works. On the other hand, ammonium cyanide is very generally met with in all liquors; and the proportion of volatile cyanide has proved to be unusually high in the coke-oven liquors.

Hypothesis A was therefore adopted as the working one in the present research. Stated briefly, it indicates that the formation of "blue salt" proceeds in three stages:

(1) Formation of ammonium ferrocyanide—

(*a*) $6NH_4Cy + FeS = (NH_4)_4Fe(Cy)_6 + (NH_4)_2S$.

(2) Formation of ferrous ferrocyanide—

(*b*) $(NH_4)_4Fe(Cy)_6 + 2FeSO_4 = Fe_2Fe(Cy)_6 + 2(NH_4)_2SO_4$.

(3) Oxidation of ferrous ferrocyanide to prussian blue—
$Fe_2Fe(Cy)_6$ oxidizes first to ferrous ferricyanide (Turnbull's blue), $Fe_3[Fe(Cy)_6]_2$, and finally to ferric ferrocyanide (prussian blue), $Fe_4[Fe(Cy)_6]_3$.

Mr. Linder describes all these stages, and then gives details of the series of experiments carried out at the East Greenwich station of the South Metropolitan Gas Company (in conjunction with Mr. Sutton), to which reference was made last week. During the whole period of testing, the works saturator itself was yielding white salt, and ferrocyanide was absent from the liquor entering the still as well as from the spent liquor leaving it. The results are summarized as follows.

The model saturator employed consisted of a glass funnel, 6 inches in diameter, luted in a deep porcelain dish, 8 inches in diameter and $3\frac{1}{2}$ inches deep, with a working capacity of 1 litre. The stem of the funnel was fitted with a glass T-piece to simplify the connections. One limb of this carried the "ammonia pipe"—a glass tube sealed below in the working liquor; the other provided a way of escape for the "foul gases," which were either discharged direct into the air or led away through a cyanide exit catch as desired. A supply of ammonia gas was obtained by tapping the ammonia pipe to one of the works saturators 2 feet above the crown. The gas was led through a double glass trap to ensure removal of suspended liquor before use in the manner described. The absence of ferrocyanides from the ammoniacal gas used was thus considered to be absolutely ensured.

The liquor employed throughout the experiments was a hot saturated solution of sulphate crystals obtained from the bins. White crystals were selected, containing only traces of associated sulphides of lead and arsenic, and entirely free from oxidized or oxidizable ferrocyanide compounds. The condition of the liquor as regards iron and acid contents was adjusted by the addition of ammonio-ferrous sulphate (1 c.c. = 0·01 gramme Fe) and pure diluted sulphuric acid (1 c.c. = 1·136 gramme H_2SO_4; sp. gr. 1·725). The former was added to the bath before the experiment started, to ensure the separation of the sulphate from a liquor of constant (iron) strength; the latter was run in from time to time under the surface of the liquor from a burette delivering into a thistle funnel, according to indications afforded by a quantitative test of the exit gases. The temperature of the liquor was regulated by a thermometer; and it was maintained at the necessary elevation by means of a bunsen flame under the porcelain dish. At the end of an experiment, the porcelain dish was removed, its contents thoroughly mixed, and samples taken for analysis.

Analysis of Bath Liquor Crystals and Finished Liquor.

Bath Liquor.—Samples of liquor were withdrawn by a pipette from time to time throughout an experiment, and examined for ferrous ferrocyanide by the oxidation test. The most suitable reagent for this purpose proved to be hydrogen peroxide. The addition of a few drops of peroxide (10 volumes) to the acidified liquor caused it to assume a deep blue coloration when traces only of ferrous ferrocyanide were present; but with larger amounts, a blue precipitate separated. Concentrated nitric acid also served the same purpose, or ferric chloride. In no case were the experimenters able to obtain any blue coloration with the saturated sulphate liquor used in the bath. The progressive formation of ferrous ferrocyanide in certain of the experiments was indicated by the increasing depth of blue obtained in the peroxide test; but no quantitative significance is attached to the results afforded by this test. In general, the iron contents of the liquor were in excess of that required to convert the whole of the ferrocyanide formed into insoluble ferrous ferrocyanide, even when no iron was added to the bath. In only one case—viz., (*c*) in the table—were they able to convert the whole of the iron

Experiments on the Formation of "Blue Salt" at the East Greenwich Works of the South Metropolitan Gas Company.

Conditions.	Duration of Experiment.	Temperature. Deg. C.			Total Iron Present in Solution. Gramme per Litre.		Total Acid Calculated as H_2SO_4. Grammes per Litre.		Remarks.
		Max.	Min.	Average.	Before.	After.	Before.	After.	
Series A.	Min.								
Bath strongly acid throughout . .	70	104	100	102	0·05 (about)	0·04	*120	115	Bath brown throughout. Concurrent bath liquor tests indicate absence of ferrocyanide. Sulphate crystals, fished from finished liquor, grey; remain grey on treatment with peroxide.
Series B.									
Bath allowed to become alkaline, then re-acidified—									
(*a*) High temperature, low iron .	70	105	85	98	0·05	Nil†	*1	12 (alkalinity)	Bath black during alkaline stage, brown during acid. Concurrent tests indicate presence of traces of ferrocyanide. Sulphate crystals black (with FeS); acidified turn grey; turned light blue by acid peroxide or nitric acid.
(*b*) High temperature; high iron.	55	104	103	103	0·37	0·37	*4	40	Bath black when alkaline; much frothing. Concurrent tests indicate presence of decided traces of ferrocyanide. Sulphate crystals grey; turned decided blue by peroxide.
(*c*) Low temperature; low iron .	80	90	65	82	0·07	Nil‡	*2	1	Bath black at first, finally brown when all the FeS had been converted into ferrocyanide bodies. Concurrent tests indicate presence of decided traces of ferrocyanide. Sulphate crystals fished from alkaline liquor, grey; turned light blue by peroxide. Do. from acidified liquor, grey; turned blue by peroxide.
(*d*) Low temperature; high iron.	120	70	90	82	0·37 (about)	0·14	*4	26	Bath black when alkaline; much frothing. Concurrent tests indicate presence of much ferrocyanide. Sulphate crystals, grey; turned deep blue by peroxide.

*Acid added in unknown amount as experiment proceeded. † All precipitated as errous sulphide. ‡ All precipitated as ferrous ferrocyanide.

Note.—The conclusions arrived at from a study of the above results undoubtedly support Hypothesis A. The results indicate generally that high iron content and low temperature, synchronizing with a period of alkaline working, are conditions most favourable for the production of "blue salt."

present into that body within the time (one to two hours) available for a single experiment.

Exit Gases.—The exit gases were tested for ammonia with turmeric paper, for sulphuretted hydrogen with lead paper, and for hydrocyanic acid by absorption in a magma of ferrous oxide and caustic soda—the ferrocyanide formed being identified in the usual way. In all the experiments without exception, hydrocyanic acid freely passed through the liquor, even when this was much below the boiling-point, and contained a large amount of suspended sulphide of iron. This point is one of importance. It indicates that reaction between the sulphide of iron and ammonium cyanide is very partial, even in a "cold" alkaline saturator. An alkaline period of working does not necessarily, therefore, involve the fixation of sufficient hydrocyanic acid to cause noticeable coloration of the sulphate. This is only likely to occur when disorganization is somewhat prolonged, or when a series of alkaline stages lead to the accumulation of ferrous ferrocyanide in the liquor.

Finished Liquor and Crystals.—By "finished liquor" is meant the liquid, crystals, and associated precipitate obtained in the bath at the end of any experiment. Samples were stored in closely stoppered bottles full to the neck, and allowed to cool. The clear supernatant liquor was then examined for sulphide, cyanide, and ferrocyanide qualitatively, and for acid and iron contents quantitatively. The acid was determined by titration with alkali (methyl orange indicator); the iron by special methods now to be described.

Estimation of Iron in the Saturator Liquor.—Two colorimetric methods were tried—the first based on the use of ferrocyanide, the second on the use of thiocyanate. The results obtained were perplexing and anomalous. In the case of some liquors, identical figures were obtained by the two methods; in others, the

thiocyanate results were much lower than those yielded by ferrocyanide—little more than half as great. It is quite impossible, therefore, to attach much importance to the figures; but they serve to indicate with rough approximation the amount of iron present in the liquors from which the sulphate crystallized. [The two methods are described in the report.] Of the results obtained, those yielded by the ferrocyanide method were considered to be the more reliable, and these alone are presented in the table.

Crystals.—These were examined for oxidizable ferrocyanide compounds by adding peroxide of hydrogen to the acidified mass. Oxidation to prussian blue is thus immediately produced. The colour developed in this way was used as a standard to compare the rate of oxidation effected by exposure of the crystals to air under conditions varied as regards acidity, dryness, &c.

For convenience of reference, the more important observations recorded during the experiments are brought together in the table. Mr. Linder explains that the figures for "Total Iron" and "Total Acid" present are calculated to 1 litre of the settled liquor before and after treatment with the ammoniacal gas. These volumes do not necessarily correspond, as the amount of acid added, and of evaporation suffered, is not exactly recorded. It was considered to be of secondary importance to ascertain such data exactly, and to do so would have interfered with the free removal of samples for examination during the course of the experiments—a procedure which was essential for the due conduct of the work.

Analysis of Gas Liquor, Spent Liquor, and Works Saturator Liquor.

The analysis of the gas liquor used in the still during the course of the experiments indicated the complete absence of ferrocyanide. This body was also absent from the spent liquor and from the works saturator liquor as tested with peroxide of hydrogen—facts which entirely exclude the possibility of accounting for the "blue salt" obtained on the occasion of the tests by the priming over of this body from the still. Theory indicates that the composition of the saturator gas yielded on distillation of this liquor would contain per 100 volumes of permanent gases; H_2S, 24·3; HCy, 2·8; CO_2, 72·9. The presence of notable traces of hydrocyanic acid was confirmed by the qualitative tests applied to the exit gases leaving the model saturator.

Sulphate Crystals Fished from the Finished Liquor.—The sulphate and associated precipitate was grey. No change was noticed in its appearance on keeping under the liquor in a stoppered bottle, even after several weeks. On drying on a water bath, the salt turned white where ferrous ferrocyanide was absent. When present, the process of oxidation commenced from the first, and continued for many days; the full depth of colour, as judged by comparison with the sample treated with peroxide, only being reached after three weeks or a month. The amount of free acid or moisture in the salt did not appear to markedly hasten the rate of oxidation; alkali, on the other hand—*e.g.*, ammonium carbonate—appeared to retard it. But the evidence on this point was not very decisive.

Behaviour of the Finished Liquor.—This was very characteristic. On agitation followed by rest, the solids separated into stratified layers; the larger and cleaner crystals being at the bottom, the flocculent precipitates above, while the finer particles of ferrous ferrocyanide settled last of all. The crystals could thus be somewhat freed from associated impurities by mechanical means. Such a process of selection appears to occur in saturator working in certain works—*e.g.*, where the saturator is closed and steam ejection employed to throw out the salt. In these works stratified layers of pure and impure salt are often noticed in the bins. The impure salt should contain the bulk of the ferrous ferrocyanide in cases where working conditions have favoured the formation of this body. Doubtless, on ejection, this is the case; but the liquor draining down from the hot mass carries with it much of the lighter and suspended particles, with the result that the upper layer of impure crystals remains grey or dull green on exposure to air, while the layer of white salt below it becomes deeply stained with prussian blue. The property possessed by ferrous ferrocyanide (or ammonium ferrous ferrocyanide) of remaining suspended in the liquor while the heavier crystalline solids settle out would tend to bring about an accumulation of ferrocyanide bodies in the saturator over periods of working that may include alternating alkaline and acid liquor conditions. The salt that is ultimately obtained in the bins may thus have been formed at a much later period than the ferrocyanide bodies that discolour it; and the working conditions that exist at the moment when the salt is ejected cannot, therefore, with any degree of certainty, be held to be those existing when the ferrocyanides were formed. It must further be remembered that oxidation of the ferrocyanide compounds to prussian blue is retarded under certain conditions, and that the appearance of the salt on ejection affords no certain guide as to its degree of purity. These considerations indicate that recorded observations stated to have existed when blue salt was being produced must be treated with considerable reserve. On the other hand, the oxidation test for ferrous ferrocyanide enables this body to be detected in the saturator itself. It is only necessary to add to the acidified liquor a few drops of hydrogen peroxide, or a few cubic centimetres of concentrated nitric acid, to develop the full colour at once, and thus obtain evidence at any moment of the extent to which the mischief has proceeded.

As regards the discoloured salt, no simple and ready way suggests itself for removing or bleaching the prussian blue associated with the crystals. Returning the product to the saturator in small charges for working up with a fresh batch of clean salt is, undoubtedly, effective; but in such a treatment the prussian blue is only reduced to white ferrous ferrocyanide, and largely diluted, not removed in the soluble form. On exposure to air, re-oxidation would again take place; but the resulting colour would be so far diluted as to escape notice.

"Blue Salt" in Saturator Working.

Mr. J. W. Young, the Inspector for the Northern District, through whose co-operation many of the more important samples of ammoniacal liquor analyzed by Mr. Linder were obtained, has recorded some interesting facts relating to the genesis of "blue salt" in certain works in his district. His contribution to the subject is as follows.

A. *Gas-Works* (1).—Last autumn the larger still and saturator consistently made "blue salt" for a few days—a most unusual occurrence there. No reason could be given, till, on stopping the plant for examination, an iron stay within the saturator, which normally was protected by lead, was found to have lost its lead covering, and to be almost entirely eaten away by the vitriol. There was, therefore, an exceptional amount of sulphate of iron in the saturator bath. After remedying this, "blue salt" ceased to be formed. When the larger plant was stopped, the smaller was set working, at first with good results. Later on, however, "blue salt" was formed here too. On testing, ammonia was found to be passing away with the foul gas, and it was also noticed that there was much less "boil" than usual in the saturator. On stopping, it was found that the delivery-pipe from the still had broken off near the elbow at the bottom of the saturator, so that ammonia vapour was not getting its usual intimate admixture with vitriol. After remedying this, "blue salt" ceased to be formed.

(2) The still is of good English pattern, and the saturator of Taylor's best heavy lead pattern, with interposed catch-boxes. I have never seen any but good white salt here before. A little while back, the production of "blue salt" was noticed, and also that there was less "boil" in the saturator than usual. Ammonia was noticed in foul gas passing to the Claus plant. On investigation, it was found that the holes in the ammonia distributing pipes behind the apron of the saturator were much enlarged. It was evidently one of the many cases of local alkalinity.

B.—*Otto-Hilgenstock Coke-Oven Works.*—(1) These works made "blue salt" habitually at starting; but of late had lost the habit. One Sunday, however, early in January, the steam supply was short and irregular, and "blue salt" was at once formed. I visited the works the following day, when the same acid and gas liquor were in use; but the supply of steam was normal. The salt then being obtained had no blue tinge. At these works there is no catch-box between the still and the saturator.

(2) The plant was formerly of the usual Otto-Hilgenstock pattern, without a catch-box; but now there is a large Colman still and saturator of the most modern construction. The colour of the salt is, however, little better. They consistently try to get a larger daily production than the plant is adapted for.

(3) Here occurred the most interesting instance. On a visit in February, two stills and saturators were at work. The north one had been going on several months; the south one, for four or five days only. Each was being supplied with the same acid and the same gas liquor. The north still was making good white salt; the south, "blue salt" ever since it started. The constructional and working details were identical, and there was an equal amount of "boil" in both saturators. There are no catch-boxes.

It would seem that among the inducing causes of "blue salt" are: (*a*) Excessive amount of salts of iron in saturator bath, as in A (1); (*b*) local alkalinity, as in A (2); (*c*) deficiency of "boil," and therefore lower temperature in the saturator, as in B (1), which I have noticed concurrently with "blue salt" at some gas-works, but not in all cases; and (*d*) excessive hydrocyanic acid in the still gases, as in B (2 and 3).

I have given much thought to the latter case (B, 3) without arriving at any satisfactory conclusion. The only suggestion I can make is that the interior of the north still had, by long use, acquired a protective covering, while the interior of the south still was either clean or rusty iron; and that either by priming or as an unknown volatile salt, iron was conducted to the south saturator.

Mr. Young obtained samples of the ammoniacal liquor distilled and acid used, and of the mother liquor from the north and south saturators at works B (3) at the time of the phenomena noted by him; and they were submitted to analysis by Mr. Linder with the following results.

—	North Saturator Making White Salt.	South Saturator Making Blue Salt.
Started working	Some months previously.	Four or five days.
Sulphate crystals	In liquor, white; exposed to air or treated with concentrated nitric acid, do.	In liquor, white; exposed to air or treated with oxidizers, decided blue.
Saturator liquor, cold, settled—	Grammes per Litre.	Grammes per Litre.
Hydrocyanic acid (HCy)	0·075	0·064
Total acid calculated as H_2SO_4	127·500	107·000
Total iron by ferrocyanide method	0·800	0·360
Calcium salts	Slight traces	,,
Acid used—		
H_2SO_4	130·800	130·800
Iron	0·420	0·420

Analysis of the "Blue Salt" from the South Saturator.

Dried at 105° C., it contained per 100 parts—

Ammonium sulphate—$(NH_4)_2SO_4$—calculated from NH_3 found.	99·53
Acidity, calculated as H_2SO_4	00·25
Insoluble (includes the blue compound)	00·13
Difference	00·09
Total	100·00

The blue compound was insoluble in water. It showed some tendency to pass through the asbestos floor of a Gooch crucible; and it was therefore exceedingly difficult to separate the whole of it from the crystals. The total weight obtained, after seven hours' continuous washing with hot water and dried at 105° C., was 0·53 gramme. It yielded by treatment with caustic soda—

Ammonia, calculated as NH_3	0·025 gramme.
Ferrocyanide, calculated as HCy	0·140 ,,

This corresponds to ammonium ferrous ferrocyanide—$(NH_4)_2Fe.Fe(Cy)_6$—0·263 gramme, which by theory contains—

Ammonia (NH_3)	0·029 gramme.
Iron (Fe)	0·097 ,,

The insoluble residue left on digesting the crystals with water contained, therefore, about 50 per cent. of a body whose composition approximates to that of ammonium ferrous ferrocyanide, the remainder being lead sulphate and other impurities contributed by the acid.

Assuming that this ferrocyanide body was formed in the saturator by interaction between iron and hydrocyanic acid under conditions of which there is no exact record extending over the whole period of working (four to five days), it is of interest to inquire whether the acid used carried with it iron sufficient to yield the whole of the insoluble ferrocyanide compounds in the ejected (blue) salt, or whether it is necessary to assume, either (1) that iron from other sources had been introduced—*e.g.*, rusty bolts, iron bogies, spades, &c.—with the mother liquor returned to the saturator; or (2) that iron had accumulated in the saturator from the removal of salt and water (by evaporation).

The "blue salt" from the south saturator contains, per 100 grammes dry, 0·130 gramme insoluble—

$$= \tfrac{1}{4} \times 0{\cdot}130 = 0{\cdot}065 \text{ gramme ammonium ferrous ferrocyanide}$$
$$= \tfrac{112}{304} \times 0{\cdot}065 = 0{\cdot}024 \text{ gramme of iron.}$$

Now, 100 parts of $(NH_4)_2SO_4 = \frac{98}{132} \times 100 = 74$ grammes of H_2SO_4; therefore 74 grammes of H_2SO_4 should carry at least 0·024 gramme of iron to discolour the sulphate yielded by it = 0·032 gramme of iron per 100 grammes of H_2SO_4. Now, 100 c.c. of the acid used (weight 130·8 grammes of H_2SO_4) contain 0·042 gramme of iron; consequently, 100 grammes of acid contain (0·042 × 100) ÷ 130·8 = 0·032 gramme of iron. We see, therefore, that the acid carries sufficient iron to account for the whole of that present in the colouring matter associated with the sulphate. The fact that there is, in addition, a large excess of iron (0·36 gramme per litre) in solution in the liquor from which the impure crystals have separated indicates that one or other of the causes suggested above must have operated.

In the absence of a complete record of the conditions existing in the south saturator from the start, it is not possible to adduce this example in support of Hypothesis A. But the facts recorded by Mr. Young are generally favourable to it than otherwise. The iron content of the south saturator was undoubtedly high, even after the removal of a considerable amount of iron in the form of insoluble ferrocyanide; and the volatile cyanide in the gas liquor distilled was unusually high (the saturator gases by theory contained 17 to 18 per cent. of hydrocyanic acid). The saturator was recently started; its temperature cannot, therefore, at the start have exceeded 100° C., and was probably much less. This period of "low temperature" working synchronized with a period when the adjustment of acid to gas could not have been exact. We have, however, no exact data as to the temperature and condition of the liquor, and can only say very generally that this would be favourable rather than unfavourable to the fixation of hydrocyanic acid.

Bibbero's "Invicta" Incandescent Burner.—In the "JOURNAL" for Dec. 27, 1904, an illustrated description of this burner appeared. Its distinctive features are that, by an external arrangement of cover and cone, the burner is made dust and wind proof, and, at the same time, very fine adjustments of the primary air supply can be made. The burner has now been in use for some time; and testimony can be made as to its efficiency for its designed purposes. In connection with this burner, we also noticed the use of Breeden's patent bye-pass tap, which allows sufficient gas to pass to form, when the burner is not in use, a small bunsen flame inside the mantle, instead of the white flame of the ordinary bye-pass jet. Mr. Bibbero is now making an alteration in this useful bye-pass tap, so that, by a separate connection, only a small atmospheric jet will be used instead of the complete ring of atmospheric flame playing round the burner-head. There has been a dispute with other patentees in connection with the anti-vibrator in which Mr. Bibbero is interested; but a settlement has been arrived at by which use can be made of the part over which the trouble arose. Messrs. Falk, Stadelmann and Co., have the sale of these arrangements in their hands; and they are manufactured by Messrs. Breeden and Co., of Birmingham.

LIGHTING MILLS AND WORKSHOPS.

Gas Cheaper than Electricity.

At a Recent Meeting of the British Association of Textile Managers, Mr. A. POLLITT read an instructive paper on the above subject. We have received a copy from the author, and make the following extracts.

In considering the lighting of mills and workshops by artificial means, I will at the commencement say that general illumination must fulfil the following conditions: It must be amply adequate in amount, suitable in kind for the work we have in hand, and so applied as not to act injuriously upon the eye. In considering the means in which these conditions may be embodied, we need not trouble ourselves with any other than those provided by gas and electricity. And in contemplating what form of light to adopt, the qualifications that must weigh with us will be: (1) The best for the character of the work engaged in. (2) For a given quantity of light, which system is the least costly in capital expenditure and subsequent upkeep and maintenance? And (3)—this is also very important—which is the least harmful to those who are compelled to work for long periods in the atmosphere affected by the system of lighting?

The second question is perhaps the most important—but as a rule is least taken into account—of all that ought to weigh in coming to a decision. Experience alone can help us to a correct conclusion, for I know of nothing so beset with difficulties as the question of "quantity" of light. When one attempts to fix a basis, and weigh against each other the results arrived at by experts in the different systems they advocate, bewilderment is complete. Professor J. A. Fleming, one of the greatest authorities on the theory and practice of electric lighting, says that a unit of electricity will keep an average 16-candle power lamp going for 18 hours, which, with electricity at 5d. per unit, gives a cost of 0·312d. per 16-candle power per hour. Having apparently thus found something tangible, we next look up an article on "Gas Lighting" by Professor Vivian Lewes, who is quite as high an authority on gas lighting as is Professor Fleming on lighting by electricity. From him we learn that 1000 cubic feet of gas will keep a 60-candle power incandescent burner going for 286 hours, which, with gas at 2s. 6d. per 1000 cubic feet, gives us 16-candle power for a cost of 0·04d. per hour. This represents one such burner as being equal almost to four incandescent electric lamps in volume of light—or giving the same amount of light at one-eighth the cost. Results such as these can each, of course, be vouched for as to their accuracy; but they are obtained under conditions that are ideal for their purpose. This compels us to discount their deductions; for few (if any) mills are so constructed as to be ideal in facility for lighting. The discrepancies in the results may also be accounted for by the fact that each would take the amount of light generated or produced—not the amount available and useful to the human eye. The latter is a very different affair indeed, for all luminous bodies emit useless as well as useful rays, when light alone is the object. The luminous efficiency of any source of light—that is to say, the percentage of rays emitted that strike the eye as light—varies considerably; and this, taken into consideration with the difference in radiation, accounts for statistics being so much at variance, and also for our sometimes being disappointed with the light we get when a stated candle power has been previously given. It is this question of radiation and diffusion of the light-rays emitted that brings about our difficulty in deciding which is the cheapest light, and accounts for my statement that figures derived from actual use are the only true guide, and the only ones upon which I shall rely to-night.

GAS LIGHTING.

Lighting by gas received a great impetus, and a new lease of life, by the discovery of the incandescent mantle—the result of many years of continuous work, dating really from the year 1835. In that year Talbot first noticed that blotting paper soaked in a solution of calcium chloride, and burnt in the flame of a spirit lamp, left a white network of ashes, which, when heated in the feeblest flame, gave a very brilliant light. The work continued unbroken from that time down to the latest development of the Welsbach mantle, which gives lengthened life, kinder light, and an increased efficiency as compared with those of only a few years ago. Supplied from the ordinary pipes, but with an addition of an anti-vibrator, incandescent gas-burners have been adopted in many large weaving-sheds and spinning-rooms. Although dust is very detrimental to the efficiency of the mantles, yet by careful and regular attention this can be maintained, at a cost of 14s. per light, including all pipes, fittings, and labour; and, for a consumption of 3½ cubic feet of gas per hour, the user may rely upon an average illuminating power of 60 candles, which is more than ample for two looms, or is sufficient for lighting an area (if unobstructed by machinery) of 30 square feet.

A further advance in gas lighting is one dependent upon the use of intensified or compressed gas. The system is a combination of the incandescent mantle with the use of ordinary gas at an increased pressure. The best known of these systems is that of the James Keith and Blackman Company, Limited, in which the normal pressure of ordinary gas is automatically increased to 8 inches water-gauge by a compressor. After leaving the compressor, the gas is distributed through the usual pipes to burners specially

designed for this system. The construction of the burner, in conjunction with the increased pressure, ensures enough air being drawn in and mixed with the gas to give complete combustion, and very greatly increases the illuminating effect. The compressors are made in various sizes, for installations of from 2000-candle power upwards, and are usually operated by water pressure from the street main; but they may be driven by belt or small motor if preferred. The power required is very small indeed; and if connected to the water-main, the apparatus is perfectly automatic—there being no water consumption without a corresponding demand for gas. The cost of the water does not exceed more than 1d. for every 1000 cubic feet of gas compressed; and in my comparisons of the different systems, I shall include this in the price of gas—charging to this plant 2s. 7d. per 1000 cubic feet, as against 2s. 6d. for the others. This, however, is a charge that need not in every case be made, for the water after use in the compressor is fit for most industrial purposes, and may be led away to any part desired, especially if the water pressure on the main is such that it enables the compressor to be placed overhead or on the roof itself.

For any trade where large areas are to be lighted, or where an abundance of light is required, this system is specially applicable. I have had the pleasure of inspecting recently a modern engineering works where this light had been in use for some time; and the management spoke of it in the highest possible terms from every point of view. In one department, the light had been put to work under perhaps the most trying conditions possible; and yet the greatest satisfaction (I was assured) had been derived by its adoption. This was in the iron foundry, where (as we all know) there is an abundance of dust, and where the ceiling and walls do not lend any assistance in the reflection and diffusion of the light. The burners are usually of 150 to 300 or 600 and upwards candle power. In these works there were eighteen lamps of 1000-candle power each and two of 500 candles—a total of 19,000-candle power, for a consumption of 778 cubic feet of gas; or, with gas at 2s. 7d., 19,000-candle power for 2s. 0·118d. per hour.

Following the successful introduction of this method of lighting, came the Welsbach-Kern self-intensifying lamp, which may be said to aim, by the special construction of burner and lamp, at the same result as had been achieved by the compression of the gas in the Keith light, but in this case without the compressor. The best lighted workroom I have ever seen was one fitted with 43 of these lights, of 160-candle power each—a total of 6880-candle power, from a consumption of 323 cubic feet of gas per hour; or, with gas at 2s. 6d. per 1000 feet, 6880-candle power at 1s. 8·64d. per hour. The cost per lamp, including all pipes, fittings, and labour, was 53s. each. These 43 lamps had displaced 143 No. 6 batswing gas-burners, with a candle power of only 2320, but with a consumption of 797 feet of gas. The area of the room was 6030 square feet; the whole was brilliantly lighted; and the work carried on was of a most exacting character, and in all colours.

Electric Lighting.

Lighting by means of the electric incandescent lamp needs little or no description. We are all more or less acquainted with the advantages that are claimed for it as against any other method of lighting. Many mills (chiefly new ones) are adopting this system at the present time; but its adoption for existing ones has received a check by reason of the success of those methods I have mentioned—for its strongest advocates cannot claim that economy is one of its advantages, when compared with gas in its recent methods of application. If, however, lighting by electricity has been decided upon, the question to be answered is, Shall we generate the current ourselves, or take it from a public supply, assuming that one is available? I should say that where you can buy current at 3d. per unit or less, take it from an outside source; where this cannot be done, generate it yourself. There are advantages and disadvantages, other than that of price of current, in following either course. On the one hand you have not the anxiety and trouble of maintaining a plant of your own; but on the other you have the very great advantage of always having your current at the pressure that gives the greatest efficiency and satisfaction. This is most important. If the pressure exceeds that for which your lamps are made, their life is shortened, and the cost of upkeep consequently becomes greater; but if the pressure be too low, the loss in candle power is very great, and is altogether out of proportion to the fall in pressure from the normal working one. This would not be so serious if the loss were (say) one-candle power for a drop of one volt, and so on. But the ratio is much greater than that; and I venture to say that more dissatisfaction with the electric light has been caused by the pressure not being maintained than by all other causes put together.

If a complete installation be decided upon, modern practice favours a generating plant complete in itself, with inverted high-speed engine, with extended crank-shaft coupled to a dynamo on the same bed, with a speed of from 400 to 450 revolutions per minute and a pressure of 220 volts; or, if the power be available from an already existing source, the same voltage, with rope or belt driving to the dynamo. A disadvantage in generating your own current is that the space is occupied and the capital lying idle for the greater part of the year when the light is not required. In weaving-sheds, it is usual to allow one 16 candle power lamp for every two looms. With ordinary mill fittings, this would cost (including all wire, switches, and labour) about 18s. per lamp—that is if current be taken from an outside source. If the current be generated on the premises, the cost with fittings (including also all instruments and dynamo, but not engine) would be 32s. 6d. per lamp; or, including engine complete, 39s. per lamp. In my comparisons between electric lighting and other systems, I shall take the middle figures, and assume that the power is available, and that the dynamo only has to be supplied.

An installation with which I am very well acquainted has an output of 45,000 watts, supplying 800 16-candle power lamps, or a total candle power of 12,800. The first capital expenditure was £1283, and the present hourly working expenses are 8s. 5·5d., including interest, depreciation, running expenses, lamp renewals, and all other charges.

Under favourable conditions—*i.e.*, where large areas are to be lighted without much obstruction, the arc light has often been adopted. For indoor use, the enclosed lamp is by far the best. The working of the smaller lamps is more expensive for their candle power than is that of the large ones, but a better general illumination is obtained by having more lamps of smaller capacity. A very common objection to the arc light for indoor use is that it is very hurtful to the eyes when looked at. The cost per light for the size of lamp I have mentioned would be about £13; and the cost for current only about one-fourth that of incandescent (electric) light of the same candle power.

In the following table, in order to make the comparisons as fair as possible, it has been necessary to adopt a common basis for the different systems dealt with. For this purpose, I have taken in each case an installation of 20,000-candle power, with an average lighting season of 450 hours. It may be noticed that the figures tabulated do not quite coincide with those I have already given. The explanation is that the different installations of which I have given records have not all lamps of the same candle power; and, as the larger the lamp the greater the efficiency, the slight difference between the results already noticed and when brought to a size as nearly as possible uniform to them all is accounted for. Even with these results, derived from an equal sized plant, it must not be assumed that in each or any of them equal satisfaction would be obtained. The same candle power, well distributed over the same area must give the best illumination, providing (and this is an important proviso) that each form of light has an equal power of diffusion—a quality in which the electric light is unfortunately wanting.

20,000-Candle Power Installation with a Lighting Season of 450 Hours.

Plant.	Total Candle Power.	Capital Expenditure.	No. of Lights	Candle Power per Light.	Cub. Ft. of Gas per Hour.	Price of Gas per 1000 c. ft.	Cost per Hour, Gas only.	Upkeep per Hour.	Interest and Depreciation (5 % each) per Hour.	Total Cost per Hour.	Cost per 1000 c. p. per Hour.	Per Unit.
		£ s. d.				s. d.	s. d.	s. d.	s d.	s. d.	s. d.	
Ordinary flat-flame burner	20,000	468 15 0	1250	16	6,250	2 6	15 7·50	0 6·50	2 1·00	18 3·00	0 0·219	—
Incandescent mantle	20,000	233 2 0	334	60	1,086	2 6	2 8·50	1 0·25	1 0·43	4 9·18	0 0·0571	—
Welsbach self-intensifying gas-lamp	20,000	355 2 0	125	160	875	2 6	2 2·25	0 5·42	1 6·93	4 4·60	0 0·0526	—
Compressed gas	20,000	310 4 6	134	150	806	2 7	2 2·23	0 5 42	1 4·54	4 0·19	0 0·0481	—
					Watts.		Electricity.					
Electric incandescent	20,000	2031 5 0	1250	16	75,000	—	1 10·71	2 3·66	9 0·03	13 2·68	1 1·23	3·53
Electric arc	20,000	530 0 0	40	500	22,000	—	1 4 26	0 10·00	2 4·18	4 6·44	0 2·722	2·474

The death occurred on Friday, the 17th inst., of Mr. James A. Fricker, who for some years filled the position of Secretary of the Kingston-on-Thames Gas Company. He originally had a business in the town; but in 1869 he gave it up to become the first collector for the Gas Company, of which his father was the Secretary and Manager. This post he held till his father's retirement, when he was appointed Secretary. A breakdown in his health necessitated the relinquishment of his official duties about three years ago, when he was granted a retiring allowance by the Company, whose interests he had faithfully studied for nearly 35 years. He died within a few hours of completing his seventieth year. The funeral took place last Wednesday at Kingston Cemetery, when abundant evidence was afforded of the high esteem in which the deceased had been held.

DR. HABER'S REPORT ON ELECTROLYSIS AT KARLSRUHE.

As was mentioned recently, the report of the Electrolysis Commission of the German Association of Gas and Water Engineers [see "JOURNAL" for the 17th ult., p. 164] was followed by a special report drawn up by Professor Dr. F. Haber upon the stray tramway currents at Karlsruhe, and the harm they are likely to do to the gas and water pipes there.

Dr. Haber's lengthy report may be divided into three sections: First, a description of the electrical and electro-chemical phenomena of stray tramway currents; secondly, of the methods adopted for tracing and measuring them; and, thirdly, of a review of the conditions found to exist at five different places in the streets of Karlsruhe where both tram lines and mains exist.

ELECTRO-CHEMICAL PHENOMENA.

It is well known that an iron anode in an alkaline electrolyte does not dissolve, but becomes passive. Hence the question arises whether metal dissolves, or whether, becoming passive, it allows oxygen to be given off, when current escapes from an iron pipe lying in the ground. Experiments, however, show that passivity underground is an extremely rare phenomenon. When two pieces of black iron plate were immersed in a 1 per cent. solution of sodium carbonate, and a current having a density of 0·1 ampere per square decimetre was sent through them for 20 hours, no metal dissolved; but when the same plates were submerged in a similar solution made into a paste (having the consistency of ordinary soil) with sand previously washed in sulphuric acid and water, a current which liberated 3·85 grammes of copper in a voltameter caused 3·55 grammes of iron to be dissolved.* Hence underground iron pipes must be considered to exist in the active state of the metal. A coating of tar is no protection. The coating cracks, and the fissures become full of ground water; so that, tarred or not, the underground pipe is in contact with the same active electrolyte—*i.e.*, the water of the soil—under practically identical conditions. Tested in a 5 per cent. solution of zinc sulphate (which has roughly 25 times the conductivity of ground water), the coating on an exhumed pipe was found to have a resistivity of 0·017 ohm per square metre. In natural water, the corresponding figure was 0·43 ohm. This is equal to the resistance of a layer of earth 1 square metre in area by 1 to 4 millimetres thick.

When a pipe is electro-positive in respect of a (tram) rail, current passes to the rail from the pipe, attacking the latter. As the attack is often highly localized, it is sometimes imagined that the issue of current is restricted to certain spots, because at others there is a greater resistance as between the pipe and the soil. There is no such thing as resistance to the passage of current between pipe and soil. Where the soil is unusually dry, it may possess too little conductivity for the current to pass; but in moist soil there is no special obstacle to the escape of current from a pipe—coatings of tar being inert. The only local phenomenon is polarization of the pipe; but this does not change suddenly at neighbouring spots. The true cause of the attack being localized will be explained later.

The stray currents now under consideration are direct currents of electricity; and their magnitudes are determined by the three following dimensions—viz., the resistivity of the earth, the fall in potential ("P.D.") in the earth, and the current density in the earth. The resistivity of the earth (which is better returned on the cubic metre, instead of the cubic centimetre as is customary in other branches of electrolytic inquiry) is essentially the resistivity of the water absorbed in the earth; the solid earth being a non-conductor. According to Kohlrausch and Holborn's rule, the conductivity of ground water is approximately given by multiplying the amount of dissolved inorganic matter in it (grammes per litre) by 0·133; the value so obtained relating to 1 cubic metre at a temperature of 18° C. Dividing this value by the number of grammes of water in a cubic metre of soil, the quotient represents a rough measure of the conductivity of the earth per cubic metre. The conductivity can also be determined by fitting the ends of a wooden box with sheet iron plates, charging it with soil, and measuring the resistance with an alternating current and a telephone by the Kohlrausch method. The resistivity can be calculated from the resistance and the known dimensions of the box. In order that the soil in the box may have its natural density, a known volume of the soil should be dug up, and its weight ascertained; the box being then filled and rammed as may be necessary.

Several measurements have been made in this manner for the author at different places. At Breslau, where the soil is sandy, Professor Abegg has found samples taken at different depths to possess resistivities between 125 and 278 ohms. At Dresden, Professor Förster has found three loamy samples taken from a depth of 18 inches on the left side of the River Elbe to give resistivities ranging between 55 and 63 ohms; whereas a sandy sample from the right side of the river gave 244 ohms. A fat oam from Zurich, containing 300 grammes of water per litre, gave Professor Lorenz 84 ohms, and a sample from a sand-pit at Oerlikon gave him 800 ohms or more. All these figures relate to the cubic metre, to the spring time, and to a ground temperature of about 41° Fahr. Numerous measurements made at Karlsruhe show extreme values of 100 and 1000 ohms; but most of the determinations lie between 200 and 300. Loam has a low resistivity; sand a high one. It is of considerable assistance to know the resistivity of the soil in different parts of a town, because the investigator is then able to judge the relative degrees of danger to which pipes are locally exposed when a current of one and the same voltage is flowing from pipes to rails. Moreover, measurements of conductivity more easily bring to notice places where some foreign material of good conducting power may be entering or present in the soil than chemical analyses do.

The paths taken by vagrant currents in the earth may be followed with the aid of a portable non-polarizable electrode constructed in the manner now to be described. A porous cell is cemented into one end of a glass cylinder 10 inches long by about 2 inches in diameter, and the other end is closed with a rubber stopper having three holes. A wooden rod, 3 or 4 feet long, serving as a handle, is fixed in the centre hole; a thick-walled capillary tube (which can be sealed with a short length of rubber and a glass plug, or left open to admit air to the cylinder) is fitted to the second; while through the third passes an amalgamated zinc rod, which is connected with an insulated copper wire wound round the handle, and covered over all with some insulating material. The cylinder itself is filled with a paste of zinc sulphate crystals in a saturated solution of the same salt. The potentials of the pipes are measured with one such electrode and a Wheatstone bridge; P.D.s in the earth with two electrodes and a galvanometer or electrometer.

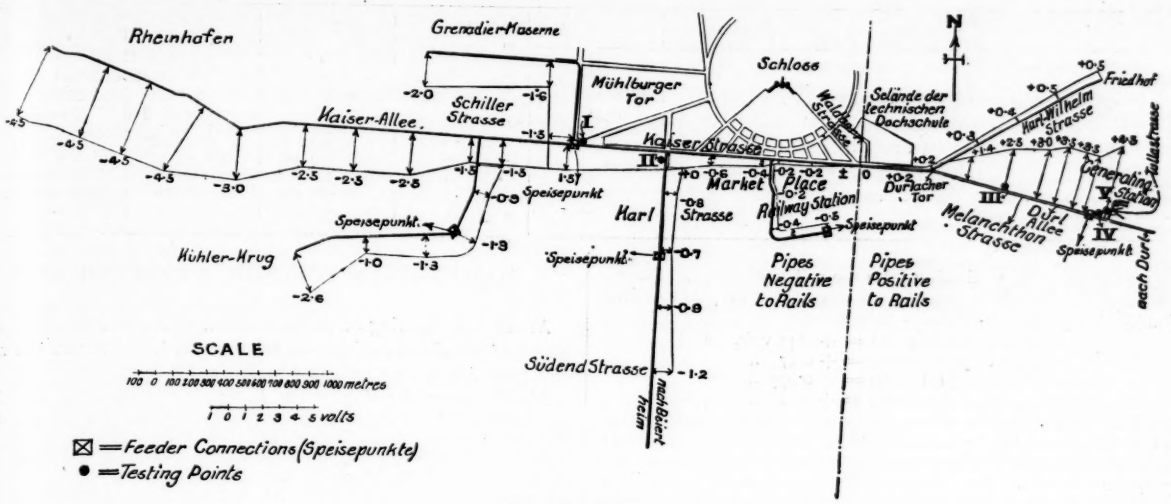
It is often thought that a large mass of metal buried to a sufficient depth in the earth, such as a water-pipe, must invariably exhibit the potential of the earth. This opinion is incorrect. The earth is actually a very extensive electrolyte brought into a pasty condition by the presence of non-conducting solid matter; and at the surface of contact between it and a pipe varying P.D.s exist according to the direction and strength of any passing current. A P. D. even exists in the absence of current; but inasmuch as the important point in the present connection is the variation in the P. D. brought about by the presence or absence of current, the P. D. in the absence of current might be taken as zero, if only that P. D. were not affected by local variations in, *e.g.*, the air and carbonic acid in the soil, and by polarization. Hence it is better to take the test electrode as a zero instrument, calculating all other P. D.s against its readings. It is not necessary to read more accurately than in centivolts, though millivolts can easily be measured.

If the test electrode is laid close alongside a buried pipe at which a spot has been filed bright, it will be found at night time, when no stray currents are flowing, that the pipe is about 0·45 volt positive in respect of the electrode. In the daytime, if current is flowing into or out of the pipe, a different reading will be obtained. The pipe is then polarized, to an extent depending on the density of the current; the polarization being greatest at the part of the pipe nearest the tramlines. If the polarization is cathodic (current entering the pipe), the P.D. between pipe and electrode is thereby diminished; but if the polarization is anodic (current issuing from the pipe), the P.D. is increased. In general, the effect of this polarization slightly exceeds 0·5 volt. A rough notion of the current density may frequently be drawn from the polarization value; but the irregularities in the P.D.s already mentioned render the result untrustworthy.

If the test electrode is put in other positions at night time, after the trams have ceased running, the difference in the P.D.s observed between the pipe and electrode will not exceed a few centivolts, provided, of course, other foreign currents are not flowing through the soil. In the day time, whenever there is any appreciable stray current, the differences at various positions will be more serious. As a basis for comparison, it is useful to remember that if the resistivity of the soil per cubic metre is 200 ohms, and current having a uniform density of 0·1 milliampere per square decimetre is flowing, a layer of soil 1 metre thick will cause a loss of potential equal to 2 volts. On employing the test electrode to ascertain the conditions prevailing in a street along which pipes and tram-rails run, it will be found that current passes from one to the other by the most direct path; and the most direct path will be found to be sensibly identical with the shortest line joining each length of pipe to the nearest length of rail. This would not be the case if round the pipe there existed a considerable electrical resistance, which only failed in certain places, allowing current to pass locally.

The quantity of current flowing in the earth may be measured by one or other of two instruments termed by Professor Haber an earth amperemeter and an earth coulombmeter. The former is constructed by fixing two sheets of copper, separated by a disc of talc, in a ring of vulcanite surrounded by a ring of wood. A paste of finely powdered copper sulphate, moistened with so much 20 per cent. sulphuric acid that the mixture can be spread over the copper in a thin layer without any liquid exuding, is then applied; and on both sides the paste is next covered with parchment paper, previously moistened with dilute sodium sulphate solution and rinsed in water (all air bubbles being removed). Soil is dug from the spot to be tested, the stones are taken out,

* These figures do not agree accurately with the requirements of Faraday's law; but the divergence is presumably to be explained by the mechanical loosening of particles of iron from the plates, the metal being not actually dissolved.



Plan of Karlsruhe,

Showing graphically the P.D. between the Tram-Rails and the Water-Mains, in Different Parts of the Town.

and the parchment papers are gently rubbed with the earth. This is thrown away, and finally more of the same earth is applied to both sides of the instrument and pressed upon the parchment until the central cavities are filled up level with the sides of the wooden ring with earth compressed to the same (or a little higher) consistency as is the case underground. Insulated copper wires join the copper plates to a delicate galvanometer of low resistance; and the apparatus is then buried at the spot under examination for a period of time not exceeding a few hours. The copper sheets have effective areas of 1 square decimetre; and the wooden ring is 4 centimetres thick. Between the limits of 0·05 and 1·0 milliampere, the amperemeter gives correct readings, and the error is trifling if the instrument is used for the measurement of currents up to 3 milliamperes per square decimetre in density.

The coulombmeter is constructed similarly, but is arranged with two silver discs in mutual contact, moistened with silver acetate and water. It requires no connections, and is buried for twenty-four hours; the silver dissolved from one plate and deposited on the other being weighed. The error of the apparatus —*i.e.*, the weight of metal transferred in the absence of current— does not exceed 0·3 or 0·5 milligramme of silver per twenty-four hours. Larger volumes of current are shown by these instruments to occur in the immediate proximity of a pipe than at some distance away; and, where pipes and rails run parallel, they indicate very little or no current if they are so buried that the plane of the metal discs lies parallel with the most direct path of the current (as defined above). This also shows that the local character of the corrosion is not due to the local absence of some resistance as between pipe and rail.

The localization of the attack is due principally to local increases in the conducting power of the soil, frequently brought about by the sprinkling of common salt on the tram track, or by the penetration into the soil of animal secretions containing common salt. But apart from this, uniform corrosion over the whole pipe surface is not to be expected. The current begins to act at the spots where there are cracks in the tar coating; the cracks grow, and neighbouring particles of the coating are undercut and fall off; the metal of the pipe varies in composition, and some portions are corroded more rapidly than others; and the iron dissolves as bicarbonate, which may perhaps act as a conductor, locally increasing the conductivity of the soil. All these things tend to increase the localization of the attack when once it has begun locally; but, on the other hand, their irregular actions may cause a certain piece of pipe to appear corroded uniformly all over.

Maximum Permissible Current.

Two important questions now remain to be answered: (*a*) What is the maximum volume of current that may leave a pipe which is still in good condition per cubic decimetre of its surface without leading to future injury, and (*b*) what current density must be regarded as definitely dangerous? There must naturally be a considerable difference between these limits, the magnitude of the difference depending on local circumstances. For the following reasons Professor Haber regards a current density of 0·05 milliampere per square decimetre as negligible. A current having the density mentioned, flowing for 17 hours per day, represents the passage of

$$5 \times 10^{-5} \times 3600 \times 17 = 3 \text{ coulombs}$$

of electricity per day from every square decimetre of pipe surface to the earth; and 3 coulombs are equivalent to the dissolution of 0·9 milligramme of iron per day, or 0·3 gramme per year. Spread over a surface of 1 square decimetre, this 0·3 gramme of iron corresponds with a layer of 1·200th millimetre thick—*i.e.*, if the corrosion were distributed uniformly, the thickness of the pipe would be diminished by 1 millimetre in 200 years. On the other hand, a current density 20 times as great, which would corrode the pipe 20 times as rapidly, must be held intolerable. Hence Dr. Haber concludes that the first limit sought for above is 0·05 milliampere per square decimetre, or 3 coulombs per square decimetre per day; and the second is 1 milliampere per square decimetre, or 60 coulombs per square decimetre per day. [Translated into British measurements the lower limit becomes 0·465 milliampere, or 28 coulombs per square foot, and the upper limit 9·3 milliamperes, or 560 coulombs per square foot.]

The Phenomena at Karlsruhe.

The general arrangement of the tramway system at Karlsruhe is shown in the accompanying diagram, where the double lines represent those streets or portions of streets through which the trams run. The electricity generating station is at the east end of the district. Current is supplied to the trolley wires at five different places, marked on the plan with crosses inscribed in rectangles. It returns to the dynamos from the end of the rails close to the generating station through a cable not provided with any resistance. Hence a special return lead connected with the rails at the market place carries but little current. The single line marked on the plan alongside the streets represents graphically to scale the P.D.s between rails and pipes all over the town; the numerical values and the polarity existing between pipes and rails being shown in figures at frequent intervals. It will be seen that the region where the pipes are positive in respect to the rails is in the vicinity of the generating station, and that its area is small in comparison with the district where the rails are positive towards the pipes. The broken line running north and south divides these two regions clearly. The danger zone is on the east. Where the pipes are relatively negative they are not endangered, unless at any point some metallic conductor should exist still more electro-negative. Special experiments upon the electrical phenomena were carried out at the five places marked with black dots. These are numbered from I. to V., travelling eastwards. Spots I. and II. are in the western zone, where the pipes are negative in respect of the rails; and the investigations made there fail to show the presence of any conductor towards which the pipes can be positive. The pipes are only electropositive to a serious extent in the two roads close to the generating station. For the purpose of comparing the readings of the coulombmeter with those of the amperemeter, it was ascertained that the trams run with average loads for an average period of 16 hours per diem in the summer and for 15 hours in the winter; therefore a current of 1 milliampere should deposit 64 milligrammes of silver in the coulombmeter during the summer, and 60 milligrammes in the winter time.

Tests were carried out in much the same fashion at all the spots marked on the plan; and to explain the methods adopted the measurements obtained at spot I. may be given in detail. The road is asphalt over ballast. The rails run approximately parallel with a water-main lying at a depth of 6 ft. 7 in. A pit was dug so as to expose a short length of the water-main, and in the earth left behind, in a straight line between rail and pipe, tests were made at six different distances from the surface of the P.D.s shown by the portable electrode. The positions of the electrode were (1) 7 ft. 8 in. below the surface—*i.e.*, under the pipe; (2) 6 ft. 7 in. from the surface—*i.e.*, immediately over the pipe; (3) 1 ft. 8 in. from the surface; (4) 5 ft. 11 in. from the surfac; (5) 2 ft. 8 in. from the surface; and (6) 1 ft. 2 in. from the surface. In the daytime, the average P.D. between pipe and rail was 1·5 volts; the pipe being negative. The pipe was 0·15 volt positive in respect of the portable electrode n position (1), and 0·09 volt positive in respect of position (2). The P.D. between positions (2) and (3) was from −0·18 to −0·28 volt. Immediately over the pipe, the amperemeter showed currents of from 0·02 to

	I.	II.	III.	IV.	V.
P.D. due to polarization of rails, resistance near them, and resistance of road surface, (*a*)	0·94 volt	0·40	1·79	2·20	1·57
P.D. between a spot 20 inches deep and the pipe, (*b*)	0·24	0·50	0 41	1·77	3·00
Polarization of pipe, (*c*)	0·32	0 10	0·30	0·53	0·43
Total P.D. pipe towards rail in day time	− 1·50 volts	− 1·00 volt	+ 2·50 volts	+ 4·50 volts	+ 5·00 volts
Current close to pipe in milliamperes	0·02 −0·1	0·01 −0·03	0·01 −0·02	0·6 −1·2	0·3
Current density milliamperes per square decimetre	0·06	0·01 −0·02	0 1	1·35	0·26 −0·52
Resistivity of soil	..	..	115 ohms	135 ohms	100 −292 ohms
Nocturnal P.D. pipe toward rail	± 0·3 volt	..	..	..	..

0·10 milliampere to be flowing from the rail to the pipe. During the night, the P.D. from pipe to rail changed from *plus* to *minus* 0·03 volt; and the intermediate values were

pipe to position (2) = + 0·41 volt.
pipe to position (6) = + 0·47 „
(5) to (4) = + 0·075 „
(5) to (6) = + 0·01 „

It will be seen that the nocturnal P.D. between pipe and the earth in its immediate vicinity—*i.e.*, electrode in position (2) = + 0·41 volt, agreeing well with the normal value previously mentioned —viz., + 0·45 volt. The corresponding day value, + 0·09 volt, shows how the pipe exhibits cathodic polarization. The current density close to the pipe, like the P.D. and the polarization, varies greatly with the conditions of traffic; its mean value being 0·06 milliampere per square decimetre. The total day P.D. between pipe and rail is made up of three quantities: (*a*) The polarization of the rail together with the resistance at its surface, and the resistance of the road surface, = 0·94 volt; (*b*) the P.D. between a spot 20 inches below the surface and the pipe, = 0·24 volt; and (*c*) the polarization of the pipe, = 0·32 volt; a total of − 1·50 volts. These figures, and those obtained similarly at the other test places, are incorporated into the annexed table. At point IV., the P.D., included in item (*b*), is measured between the pipe and a spot 16 inches below the surface; at point V., the same spot is 40 inches deep.

The high value of (*a*) at point III. is clearly due to the wooden sleepers carrying the rails being level with the surface of the road, and the low value of (*b*) to the loamy nature of the soil. Point IV. is a place where gas and water pipes cross the rails at fairly wide angles, and where the pipes are exposed to a distinct risk. The road is frequently treated with salt in the winter, as the traffic is heavy. The resistivity per cubic metre of the soil taken from a depth of 7 feet (close to the pipe) at IV. is 135 ohms; but at a depth of 3 feet it is only 47·4 to 67·5 ohms. The application of salt accounts for this lower resistivity near the surface. The total P.D. between pipe and rail was found to vary between + 3 and + 6 volts at point IV.; and since this variation affects all the other figures, it is a matter of some difficulty to obtain average data. If the experimental pit was left open for several days in order that numerous readings could be obtained, the conductivity of the soil was altered through loss of water in dry weather, or gain in moisture in wet weather. Four different pits were dug and tested at different times at spot V. The individual results varied considerably, owing to differences in the character of the soil, &c. It was found on two occasions that the pipes were carrying a small horizontal component of the current; the potential of the water-main being 0·21 volt higher at one spot than at another some 60 feet distant.

Since at a place like V. both rails and pipes have a common potential at night time of about + 0·45 volt in respect of the soil, whereas in the day time the pipes are 5 volts positive in respect of the rails, the question arises whether the rails drop in potential or the pipes rise in potential, or whether the change between day and night is distributed over both. Experiments seem to show that the pipes do not alter much between day and night; the change being produced in the rails. In the Tullastrasse at Karlsruhe, where the test place V. is situated, the gas-main, the water-main, and the rails run parallel (the water-main in the middle), and the potentials of gas and water main are sensibly identical. A distributing system may be regarded as an electrical conductor in good contact with the earth, through which conductor currents of comparatively low density flow during the day time. Judging from the conditions at Karlsruhe, the potential of the system in respect of neighbouring layers of earth is seldom affected by more than ± 0·5 volt through the escape or entry of current; and the contiguous layers of earth retain at all times sensibly the potential of the deeper soil. The tram-lines, however, are traversed by currents of much higher density, and the electrical connection between them and the earth is far less perfect than between the pipes and the earth. Hence, where they exhibit a serious P.D. in respect of the pipes, their potential in day time is very different from the normal value it has at night. Employing the common analogy, the gas and water pipes resemble a water reservoir in which the pressure does not vary much; but the rails resemble a reservoir where the head is highly irregular.

Exports of coal and coke from the United States in 1905 aggregated more than $31,000,000 in value, against $11,000,000 for 1895, a decade earlier. The United States holds third place among the nations as an exporter of coal, and first place as a producer.

GAS-ENGINES FOR SHIP PROPULSION.

At the last Meeting of the Institution of Naval Architects, a paper on the above subject was read by Mr. J. E. THORNYCROFT. The following are the principal portions of it.

At the spring meeting of the Institution in 1904, the use of gas-engines was referred to in a paper read by the author on "Internal-Combustion Engines for Marine Purposes." At that time there was practically no information available with regard to them. Just then, however, Herr Emil Capitaine was carrying out experiments with his first boat, and a number of vessels have since been fitted which have shown very satisfactory results. It is thought that a description of them, and particulars of the results obtained, will be of interest to the Institution; Sir William White having recently stated that he considers the gas-engine is bound to play a most important part in marine engineering.

Before giving details of the different vessels, it may be well shortly to describe the way a gas-engine works in conjunction with a gas-producer, and consider the possible advantages and some of the difficulties that have to be overcome. The majority of small gas-engines work on the Otto cycle, which has the advantage of requiring no special gas or air pumps; and this is the only type of engine that has been as yet tried for marine work. The gas-producer which is generally used for moderate powers, works on the "suction" principle—that is to say, instead of the gas being generated by the combustion of fuel, by air and steam being forced through it under pressure, it is generated by the air being drawn through the producer—the whole of the apparatus working somewhat below atmospheric pressure. The advantage of this system is that neither a steam-boiler working under pressure nor a gas-container for holding the gas is required; and the further very important advantage for marine work is that there is no danger from leakage of gas from the producer. If leakage takes place, it is from the atmosphere into the producer itself.

There are so many combined plants, consisting of a gas-engine working in conjunction with a suction gas-producer, at work for stationary purposes, that it might appear that only very small alterations would be required in these plants to adapt them for marine propulsion. But, in addition to the great difference between almost all marine and land plants—viz., that of the quick and frequent variations of load which the smaller types of marine plants have to undergo—there are very many features which must be changed to adapt the gas-engine and producer for boat work. In fact, it will be found that the principle of operation will be about the only thing which can be identical with the land plant; the details of the apparatus all having to be specially worked out for the new conditions. The producers for moderate-sized powers are usually worked with anthracite coal; and where vessels are to be used on fixed routes, and the same class of fuel can always be obtained, anthracite or coke will be found to be the most suitable for moderate powers—it being too difficult to make a satisfactory small plant to work with bituminous coal. For larger powers, and for vessels that have to take up fuel at different ports, the producer must be capable of dealing with coal, other than anthracite, which may be of a tarry or caking character.

The design of the producer capable of successfully dealing with bituminous or caking coal is a much more difficult problem than the anthracite producer. There are, of course, very many large land installations of pressure producers working with bituminous coal. But the apparatus for extracting the tar and other bye-products, as at present arranged, is far too cumbrous for marine work; and the marine producer to deal with this class of coal must be designed on entirely different lines, being arranged to consume the tar which is evaporated from the coal in the first stages of its heating. This has been done in some producers by taking the gas off at a comparatively hot part of the fire, instead of near the top of the new coal, as is usually the case with the anthracite producer. But there are plants now at work dealing successfully with bituminous caking coal which are fed by an under-type stoker; so that the new coal is forced into the hottest part of the fire, and the tar which is driven out is at once burned. After the gas leaves the producer, it must be first cooled; and as there will always be a certain amount of impurity, even when anthracite is used, it has to be thoroughly cleaned. This is usually done by passing the gas through a series of vessels, where it is scrubbed by its passage between layers of coke over which water is running.

It is frequently arranged that the cooling of the gas is effected by passing it over a water-containing vessel, which acts as a generator for the steam required by the producer. But there

are disadvantages in this method where the producer is not working at a uniform load, as the steam will not be generated until the producer has been working some time, and will continue when the engine has been stopped and when it is not required, and so cool the fire, causing the gas to be poor when the engine is again started.

The large space occupied by the ordinary coke scrubbers, prohibits their use for marine work; and to meet this difficulty Herr Capitaine has arranged his plant to clean the gas, after it has been cooled, by the introduction of a very fine spray of water, which mixes with the small particles of dust and other impurities in the gas, and forms a sort of fog. The gas in this stage is passed into a centrifugal apparatus, having a peripheral speed of 160 feet per second, which throws out the moisture and impurities, leaving a clean, dry gas to be drawn out by the engine. The percentage composition of this gas may be taken to be about as follows: Carbon dioxide, 6; carbon monoxide, 25; methane (CH), 1; hydrogen, 14; nitrogen, 54. It will be realized that the size of the producer for a given power is comparatively small when it is known that the area of the fire-grate necessary is only 0·05 square foot per horse power, whereas the average for an ordinary natural-draught steam-boiler, burning 15 lbs. of coal per square foot of grate area, would be 0·2 square foot. The depth of the fire will vary considerably with different qualities of coal used, but will not be usually more than two or three times the diameter of the fire-grate.

The author exhibited diagrams showing the different types of gas-producers, and gave the following particulars in regard to them: Messrs. Dowson's arrangement of suction producer is designed for using anthracite coal. The majority of the smaller suction producers will be found closely to resemble this type. A firebrick-lined steel casing is fitted with fire-bars and a closed ashpit; and in the upper part of the casing a conical hopper is placed, with the usual valves for opening and closing to admit fresh charges of fuel. The gases come off the fuel at the base of the conical hopper, and pass through a steam-generating pipe or vessel, and then away to the cooler and the scrubber. The producer is fitted with an outer casing, in which the air is heated, and mixes with the steam on its way to the ashpit. The Duff-Whitfield producer is arranged for working with bituminous fuel. In this producer, the tarry products which are evaporated from the new coal are caused to flow through the hottest part of the fire, and so are consumed before the gas passes away to the cooler. The Boutillier producer is arranged for working with bituminous fuel, which is supplied by an under-type stoker to the hottest part of the fire, so that the tar is at once decomposed, and cannot pass away with the gas. The principle upon which this producer works seems to be one of the best adapted for marine work. The Jan producer consists of a series of producers which are arranged to work in sequence; the gases of one which has been newly charged passing through another which has been at work some time, so that there are always some of the producers supplying tarry gas—the tar being consumed by one of the other producers in the later stages of the series. The heat losses in the producer itself are very small, as the whole plant can be so thoroughly lagged that practically there need only be heat passing away with the gas that is being generated. The loss from this cause may be very much reduced by using the heat to raise the temperature of air supplied to the producer. The heat efficiency, as given by Messrs. Dowson for their suction plant, is 90 per cent. As the result of a great many tests, the late Mr. Bryan Donkin gave the average heat efficiency of steam-boilers at 66·7 per cent. To start up the Capitaine producer, a fire is lighted on the bars, and the producer is then filled with fuel, air being either drawn or blown through it by a hand or power driven fan. For a producer of about 50 to 100 horse power, 20 to 30 minutes should be sufficient to give good gas. This can be ascertained by lighting the gas which is being given off, and seeing that it continues to burn with the right sort of flame. The gas first produced will have very little hydrogen in it, and will not be very powerful; and it requires the steam generator to come into operation. The steam which is added to the air entering the producer strengthens the gas by the water being decomposed, and gives the percentage of hydrogen which is shown in the analysis above referred to. The gas produced in this way is of a comparatively slow-burning nature, and may be described as poor gas, to distinguish it from town gas and some of the other gases generated by pressure producers which have a larger proportion of hydrogen, such as water gas.

There is an advantage in this slow-burning gas, as it enables the engine to work with a high compression; thus giving a larger range of expansion, and consequently a high economy. The slow-burning nature also avoids the violent shocks which occur when more powerful gases are used, and so a smooth-running engine is obtained. The producer once being set to work, it will continue to generate gas in large or moderate quantities as the engine requires it, and sucks it from the producer. The producer will probably be giving the best gas at somewhat near its full capacity, but will continue to give good gas down to a small proportion of full load. At very light loads, it is difficult to keep the fire hot enough to produce good gas; and special means must be adopted to keep the producer hot enough on these occasions.

Having now generally described the producer, the difficulties and advantages of adapting the gas-engine itself to marine work will be considered. The one great disadvantage of the internal combustion engine is the necessity of setting it in motion before it will run automatically. For powers of less than 200-horse, it is preferable to employ reversing gear, keeping the engine always running in the same direction, or to use a reversing propeller. Compressed air is being employed for starting large engines; and when once the engine is fitted in this way, the valve-gear for running the engine in either direction does not amount to very much.

For moderate powers, a single-acting engine with a trunk piston is found most convenient, as the piston does not require to be water-cooled until one about 2 feet in diameter is employed. A single cylinder of 20 inches diameter and 2 feet stroke, running at 120 revolutions per minute, will give about 100-horse power, taking the average working pressure at about 80, which is less than the figure often obtained. The same sized cylinder, working as a double-acting cylinder, would, of course, double the horse power; but, besides the additional valves, which must be an exact duplicate of those required for a single-acting engine, there is the complication of the water-cooled piston and rod. For small plants of from 100 to 200 horse power, a small auxiliary internal-combustion motor, driven by oil or some other fuel, is found most convenient for blowing up the producer, for starting it, and also for starting the main engine. For larger powers in vessels where steam capstans and steering gear are fitted, it is thought that the best plan will be to employ an auxiliary boiler, which can be heated by the gas when the whole plant is at work, and can be used independently to drive the various auxiliary and starting engines when the producer is not alight.

The average heat efficiency of steam-boilers is taken at about 66 per cent. Professor Capper has stated that the theoretical maximum thermal efficiency of the steam-engine is only 30 per cent., and only from 5 to 20 per cent. of the heat generated is ever turned into useful work. In the case of the gas-engine, the theoretical efficiency is about 80 per cent.; and in practice 25 to 30 per cent. of heat developed in the cylinder is turned into useful work. For vessels fitted with small-power compound condensing engines of less than 100-horse power, the fuel consumption will be from 2 to 3 lbs. per indicated horse power. For gas plants of this power, the fuel consumption will be less than 1 lb. per indicated horse power. For larger powers of not less than 500-horse power the economy will not be quite so marked, but will be about as follows: Steam plant (say), 1·6 lbs. per indicated horse power; gas plant (say), 0·8 lb. ditto. At this figure of one-half, the gas plant should be well worthy of adoption from an economical point of view, as, in other words, the same coal will do double the work. The stoking and the cleaning of the fire of the producer are much less than would be required for a steam-boiler of the same power; the stoking being practically automatic, and practically the whole fuel other than the clinkers is consumed. From the plants made, and from designs that have been got out for moderate powers, it would appear that the space occupied by the gas generator and engine is about the same as the steam plant; but for large powers, where a double-acting gas-engine is employed, the weight will be considerably less, as the engine will be about the same weight as the steam-engine, and the producer will be very much lighter than the boiler.

The type of engine adopted by Herr Capitaine for his small powers is built with a plate frame; no casting being employed in the engine other than the cylinder itself. A light engine is thus obtained, and there is no danger of breakage resulting from the very high pressures employed. The official report of the tests of the engine fitted to the vessel which ran in the reliability trials in the Solent last summer (which was named *Emil Capitaine*, after the inventor of the system), shows that this boat of 16 tons displacement ran at an average speed of 10 miles per hour for 10 hours, on a consumption of 412 lbs. of anthracite coal. This consumption also includes the fuel which was consumed by the producer during the previous 12 hours, when it was not in active operation, but simply smouldering and keeping itself alight; the producer having been filled the night before the trial. The amount of fuel consumed in this way is very little; but it should be taken into account when making a consumption trial. Several tugs, boats, and other vessels have been fitted with similar engines, and they are running on the Continent on the inland waterways; but, as far as is known, the *Emil Capitaine* was the first vessel fitted with a gas engine and producer to run in the open sea. Messrs. Deutz, the well-known gas-engine builders of Cologne, have fitted one of the large Rhine barges with two of their two-cylinder land-type engines and producers. The vessel is of 200 tons carrying capacity; and it is said to have given satisfactory results, running on the Rhine between Rotterdam and Cologne.

To determine the suitability of the Capitaine system for small powers, a canal barge has been fitted with a two-cylinder 35-horse power engine, and has been sent on an extended trip over the English canals. She left Brentford in charge of Mr. B. Dunell on the 3rd of January, fully loaded herself, and towing two ordinary canal barges, which she took to Birmingham. After giving various demonstrations there, she proceeded to Manchester, and after making further trials there, worked her way back to the Thames at Oxford, returning to Chiswick at the end of February. The total fuel consumed on the round trip and the various demonstration runs she made at the different places, was 5 tons 1 cwt.; the engine having been under way for 40 days. The only difficulties experienced on the trip were due to the shallowness

and the bad state of many of the canals. The particular barge to which this machinery was fitted was originally built to be propelled by steam; and it is interesting to note that a considerable gain has been effected in cargo-space by the substitution of the gas plant. In addition to the high economy which can be obtained with this plant for canal barge propulsion, there is the great advantage over the oil of absence of smell—an objection which the barge owners state prevents the adoption of the oil-motor for their work, as the cargo they frequently carry would be damaged by taking up the smell of the oil. It has been suggested that the exhaust from the engine would be dangerous in passing through canal tunnels. No difficulty from this source was experienced; and, indeed, it is difficult to see why there should be any more danger than from the carbonic acid gas given off by the boiler of a steam-barge.

To demonstrate the possibility of using gas plants for large powers, Messrs. William Beardmore and Co., who are joint owners with the author's firm of the British Capitaine patents, are constructing sets of engines of 500 and 1000 horse power to run at a speed of about 130 revolutions per minute. The 500-horse power set is generally of similar construction to the smaller sizes; the framing consisting entirely of steel plates arranged to transmit the stresses direct from the crank-shaft bearings to the cylinder heads. Cam-shafts for operating the inlet and exhaust valves are placed on each side of the cylinders, the valves being operated by rocking levers, so that when the cylinder head is removed, free access can be obtained to withdraw the pistons. The 500-horse power engine consists of five cylinders, each capable of developing 100-horse power. The reason for adopting this size of unit has been that the largest piston is being employed which it is thought safe to use without water-jacketing it. The 1000-horse power engine has the same diameter of cylinder and length of stroke; but the engine is double-acting, and the pistons are necessarily water-cooled. These large engines are started by admitting compressed air or gas through special starting-valves, and reversing is effected by an arrangement for shifting the cams for operating the valves to the right relative position for running the engine in the opposite direction. Compressed air or gas is admitted to make the engine give the first few revolutions in the required direction; the engine being uncoupled from the propeller shaft by means of hydraulic clutch or coupling for the short time while reversing is taking place.

The producers for these engines are arranged to work with bituminous fuel; the producer being stoked from the top, and the gas drawn off from the hottest zone of the producer. The green fuel on the top is pre-heated by the hot coal underneath, and the tarry products are carried through the incandescent fuel. A special feature of the producer is the arrangement for preventing the caking of the fuel and the formation of cavities, which are so difficult to avoid when bituminous fuel is employed.

The author exhibited a diagram showing the machinery space of the 7000-ton cargo steamer recently constructed by Messrs. Beardmore and Co., Limited, and an alternative arrangement which has been got out by Mr. W. W. May (Messrs. Beardmore and Co.'s engineer) to fit vessels of the same power with gas-engines and producers. With this latter arrangement a saving of 13,000 cubic feet of space is effected, besides a considerable saving in weight. The producers themselves are so small that they can be placed partially above the engines. It has been suggested that trouble would occur from the gases emanating from the producer in the confined spaces on board ship. But, if proper ventilating arrangements are made, there should be no trouble from this cause—indeed, the crew of the gas-barge already referred to frequently slept in the producer room during the trial, which was conducted in very cold weather. Though this course is not to be recommended, it indicates that there need be no danger.

With a view of ascertaining what results may be expected with producer gas, inquiries have been made of a number of large gas-engine manufacturers; and it appears that there are many engines of 250 to 400 horse power per cylinder running regularly every week from Monday morning to Saturday afternoon without a stop. The Premier Gas-Engine Company give an instance of an engine which has made a run of 51 days without a stop; the previous run being 49 days.

From the various physical changes which take place within the cylinder of an internal combustion engine, it is evident that it cannot well compete with the steam-engine so far as continuous running without cleaning and adjustments are concerned; but, from results that are being obtained in every-day use, it is submitted that the reliability is now so good that there need be no hesitation in adopting them on this account.

Library Lit by Candles.—A peculiar situation has arisen in connection with the lighting of the new Free Public Library at Rawtenstall. At the time the plans were adopted, it was intended that the building should be lighted by electricity supplied by the Lancashire Power Company. Consequently, no provision was made for gas-fittings. The Corporation have since resolved to generate their own electricity; but, the necessary plant having to be fixed, the Town Council gave power to have gas-fittings erected on the hire system. It was found, however, that it would be necessary to pull down walls and ceilings to carry out the gas scheme; hence recourse has been had to candles. These are to be eventually replaced by oil-lamps.

REGISTER OF PATENTS.

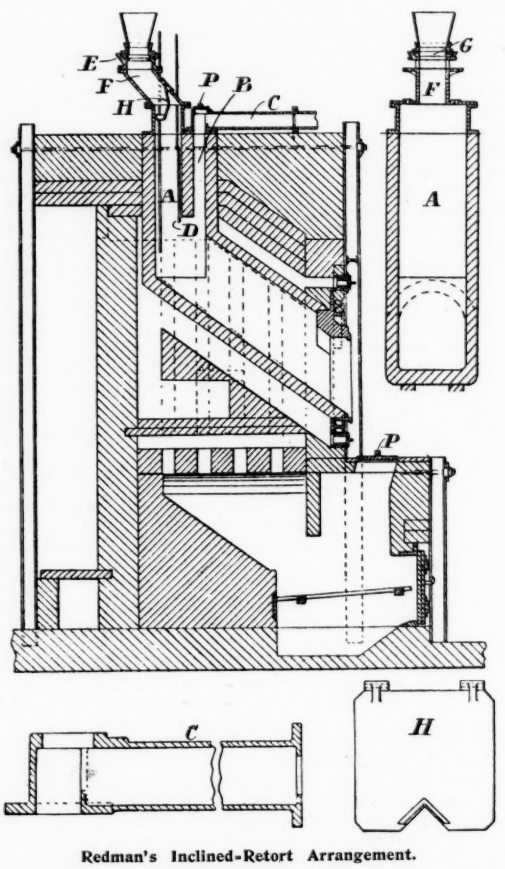
Inclined Retorts and a Method of Charging Them.

REDMAN, T., of Bradford.

No. 15,343; July 26, 1905.

This invention relates to (in the words of the patentee) "the combination with inclined retorts utilized in the manufacture of gas, certain additions, connections, and arrangement of parts applied in a manner for effecting improved conditions in carbonization, and for the charging of the retorts with coal or the like at any desired period, whether the retort is empty, or during carbonization when the retort is partly charged, and to be enabled to introduce into the retort, tar, oil, or other liquid suitable for cracking up or carbonization, and to provide means for the removal of any tarry matter that may collect in the path of the outgoing gas." To accomplish this object, the inclined retorts may be arranged and combined with certain charging devices.

In describing his invention, the patentee confines the description more particularly to a single retort (as shown). But whether one or more retorts are connected to a vertical shaft common to them all, they are heated by an ordinary furnace, suitably supplied with a secondary combustion chamber; the air supplied thereto being admitted and heated in any manner, as it forms no part of the invention.



Redman's Inclined-Retort Arrangement.

The vertical shaft A is connected to one or more inclined retorts at their upper ends—the openings through which they are charged. At one side of the shaft is an opening B, for taking away the gas evolved. This opening, during carbonization, is always in direct communication with the retorts, for taking away the gas as made to a receptacle C in pipe connection with the hydraulic main or its equivalent. The receptacle is provided with weir-plates (one at each end) for retaining the collected tar and other liquids passing away with the hot crude gas. The tar and the like impinging on the walls are deposited at the bottom between the weir-plates, so as to be removed by a suitable pipe connection.

The vertical shaft A is provided with an opening to the retort, and with a sliding stop-plate D. The capacity at the base of the shaft when the plate is lowered to the bottom is such as to retain an adequate charge of coal or the like, which, on insertion, is temporarily separated from the inclined retort by the sliding-plate. To the stop-plates rods are attached extending upwards, and by preference connected to chains passing over pullies for balancing the plate. The hopper above is inclined at the bottom to fit the angular mouthpiece E of the inclined pipe F, and is provided at the bottom with doors secured in a convenient manner and adapted to be opened for liberating the charge contained within the hopper when required. The hopper may be suspended above the mouthpiece by chains connected with pullies running on overhead rails.

When a charge of coal or the like is to be made, the sliding-plate D is moved into position for closing the opening into the retort, and the sliding cover-plate G is drawn into position so that an opening through

it is in register with the opening through the angular mouthpiece E of the inclined pipe F, secured to the junction pipe placed on top of the vertical shaft. The liberated charge, on sliding down the inclined pipe F, comes in contact with a plate H, hinged on trunnions at the top in a manner that the plate may swing thereon, and when in its normal position is as shown. On coal coming in contact with the plate it is retarded, and by sliding over the projecting angular portion, the charge is spread, and deposited more evenly at the bottom of the vertical shaft behind the sliding stop-plate D.

The plate G is adapted to slide within an opening formed through the angular mouthpiece E, and is provided with inclined projections, which, when the plate is moved into position for closing the entrance to the inclined pipe, the surfaces between the plate G and the pipe opening are made gas-tight, by the wedging of inclined projections against corresponding parts formed on the mouthpiece. When the opening into the inclined pipe is closed as described, the sliding stop-plate D is raised and the deposited charge liberated, and allowed to slide and distribute along the floor of the retort for carbonization—the gas, as evolved, passing away through the opening B.

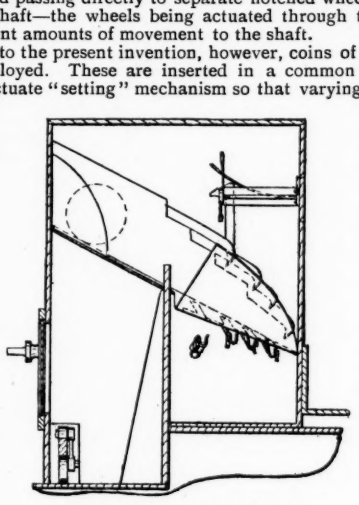
Coin-Freed Gas-Meters.

HIBBERD, C. E., of Devonport, New Zealand.

No. 17,877; Sept. 4, 1905.

It is pointed out by the patentee that it is usually proposed to use one size of coin only in a coin-freed gas-meter, the insertion of which acts as a connection between the outside handle and an internal shaft, a shaft being provided with a worm longitudinally slidable and gearing with a screw adapted to be rotated by the gas-flow. The advancement of the worm by hand operation opens the gas-valve, and its return (under the action of the rotated screw) closes the valve. In such form of apparatus, however, the advancement of the worm, when the apparatus is set, is always the same. It has also been proposed to obtain different quantities of gas by adapting the apparatus to receive two different sized coins; such coins, however, being inserted in separate slots, and passing directly to separate notched wheels, carried on a common shaft—the wheels being actuated through the coins, and giving different amounts of movement to the shaft.

According to the present invention, however, coins of varying sizes may be employed. These are inserted in a common slot, and are adapted to actuate "setting" mechanism so that varying quantities of



Hibberd's Coin-Freed Meter.

gas may be obtained according to the value of the coin inserted—a worm and screw being employed for operating the inlet valve, and the amount of advancement that the worm may be given being determined by mechanism actuated by the coin. The coins are all passed through the same slot, and run down an inclined race until they meet "directors" of varying heights, to suit the different sizes of coin, in the manner known for sorting coins in cash-registering apparatus. The directors change the course of the coins and direct them according to their sizes to different slots. A coin falls through its slot into a receptacle at the end of a coin lever, which, when operated by the weight of the coin, liberates mechanism described in a lengthy illustrated specification. One view—a side elevation of a portion of the meter—will give a general idea of the patentee's arrangement.

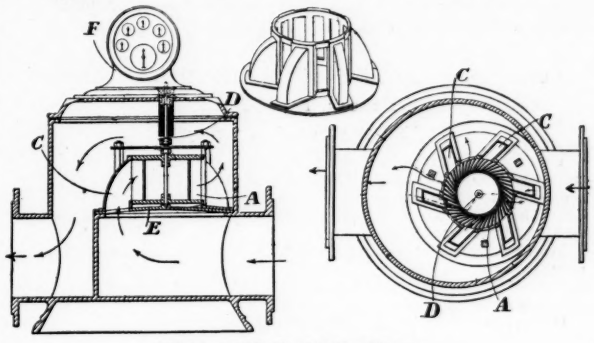
Station Meters.

WILSON, G., and FOX, T., of 'sGravenhage, Holland.

No. 17,701; Sept. 1, 1905.

This invention has for its object "to provide a compact meter of simple construction capable of accurately registering the flow of gases, and especially adapted for use as a station meter." It is of the type in which a measuring-drum having gas-tight pockets is mounted in an outer casing provided with inlet and outlet ports, and rotated by the flow of gas through the meter.

The measuring drum has its periphery provided with a series of tangentially-disposed pockets A, open at the side but closed at the top and bottom by the upper and lower plates of the drum. Around the drum are conduits C, also tangentially disposed relatively to the drum and open towards the pockets. The lower ends of the conduits communicate with the inlet port, and that side of each conduit towards the drum is open. At each side of each conduit is a flange, the face of which is shaped to coincide with the periphery of the drum. Each flange is of sufficient width to cover one of the pockets, and is set close to the drum, so that a practically gas-tight joint is obtained between it and the walls of the pockets as they pass. These flanges are all connected together at the top and bottom, so as to prevent gas escaping between the top of the drum and the top of the conduits, or from passing beneath the drum from the interior of the conduits. A convenient means of forming these flanges is to cast them in one piece with the conduits C, as shown in the detail—providing perforations or inlet ports opposite the conduits, and outlet ports between them, so that gas can first enter the pockets and leave them as required. The drum is carried by a spindle D, stepped in a bearing on a partition E dividing the inlet from the outlet. This partition is preferably convex, so that any tarry matter depositing will run off



Wilson and Fox's Station-Meter.

clear of the drum. The top and bottom plates of the drum are similarly shaped for the same purpose. The upper end of the spindle passes into a top chamber F, in which the index is mounted. The chamber F is separated by a partition from B, and depending from the partition is an annular cup, through which the spindle passes, and has secured to it an inverted cup, which dips down into the annular portion of the other cup, which is filled with oil or other suitable liquid, so that a seal is formed between the spindle and the cup, and preventing gas passing to the chamber F. The spindle D is further supported by three anti-friction rollers mounted on a bridge piece and bearing against the surface of the spindle in the well-known manner.

The operation of this meter is as follows: The gas on entering passes up the conduits C and into these pockets A which happen to be opposite the conduits. The pressure of the gas thus exerted on the pockets in a direction tangential to the drum causes the latter to rotate, so that those filled with gas are now brought opposite the outlet ports between the conduits, while fresh pockets are brought into position in front of the conduits C. The gas is thus delivered in measured quantities corresponding to the capacity of each pocket and the number of revolutions in the drum. It will be understood that the pockets as they present themselves to the conduits C already contain gas at low pressure—that is, the pressure obtaining at the delivery side of the meter; so that the capacity of each pocket is only equal to the amount of gas the pocket can receive at the higher pressure obtaining on the supply side.

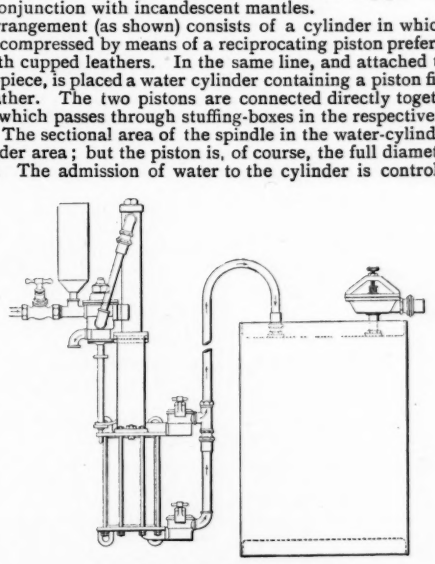
Compressing Gas and Air.

SNELL, F. A., of Clapham Common, S.W.

No. 20,431; Oct. 10, 1905.

This invention is mainly intended for use for burning gas under pressure in conjunction with incandescent mantles.

The arrangement (as shown) consists of a cylinder in which the air or gas is compressed by means of a reciprocating piston preferably provided with cupped leathers. In the same line, and attached to it by a distance-piece, is placed a water cylinder containing a piston fitted with a cup leather. The two pistons are connected directly together by a spindle, which passes through stuffing-boxes in the respective cylinder covers. The sectional area of the spindle in the water-cylinder is half the cylinder area; but the piston is, of course, the full diameter of the cylinder. The admission of water to the cylinder is controlled by a



Snell's Gas and Air Compressor.

circular balanced-valve alternately thrown to one end or the other of its casing, whereby it is caused to alternately exhaust and admit water to the top side of the water-actuated piston. The water from the supply pipe always has free access to the underside of the piston. Therefore if water under pressure is admitted above the water piston, the force is exerted over the spindle area only, or over half the cylinder area; and,

on the other hand, if the section above the piston be open to the exhaust, the annulus around the spindle will be the effective piston area, and the spindle will travel accordingly.

The main water-valve is controlled by a subsidiary miniature circular balanced valve, which works through the centre of the balanced main valve and which, by alternately exhausting and filling a cylindrical chamber at the head or upper end of valve casing in which the balanced main valve works, causes the latter valve to move in either direction in perfect obedience to the small valve. This miniature circular valve projects through the lower end of the valve casing and allows of its being actuated by a tappet arm projecting from the rod or spindle connecting the two pistons.

Controlling the Flow of Gas through Producers.

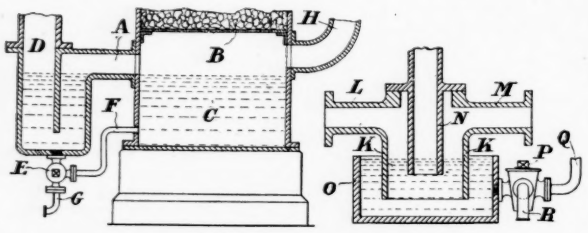
NEWTON, H., of Derby.

No. 22,512A; Nov. 3, 1905.

This invention relates to the controlling of the flow of gas through producer plant of either the suction or pressure type, so as to prevent air being drawn in and mixed with the gas in the former type of producer, and so spoiling the quality of the gas, and to prevent the gases escaping in the latter type.

To illustrate his invention, the patentee shows the base portion of a scrubber and his device for shutting off the producer from the atmosphere while the plant is in use, and a similar view without the scrubber showing a modified construction.

Direct connection is provided between the producer and the scrubber, and the scrubber has a passage leading to the chimney, normally sealed with a water-seal. This, in the first arrangement, consists of a U-shaped passage A, one end of which is open to the scrubber B, which it preferably enters at a point a little above the level of the water C in the base of the scrubber. The other end of the tube is connected with the chimney flue D. At the junction of the limbs of the U-tube is a two-way cock E, connected by a pipe F to the scrubber at a point considerably below the normal level of the water, and preferably a little above the base. The cock is adapted to put the tube either in communication with the lower part of the scrubber or with a drain-pipe G, so as to allow all the water to pass out of the seal to the drain or else into the water-seal.



Valves or Water-Seals for Gas Producers.

Assuming the water-seal to be full, gas will pass from the producer to the scrubber by the pipe H, and be forced to pass through the scrubber to the engine, there being no other outlet. If, now, it is desired to stop the engine without at the same time stopping the production of gas, by drawing the fire from the producer, the valve controlling the supply of gas from the scrubber to the engine is closed, and the cock E is turned so that the water from the water-seal passes to the drain-pipe G. When the water has completely run out of the water-seal, a free passage for the gas will be provided through the passage A to the chimney.

The modification illustrates a simple form of water-seal adapted to be inserted in the connection between the producer and the scrubber. This consists of a central pipe K, having two branches L and M, leading respectively from the producer and to the scrubber. Concentric with the pipe K is a smaller pipe N, leading to, or forming part of, the chimney flue. This pipe extends downwards into the central pipe for a considerable distance below the points at which the branch pipes enter it. The pipe K is supported with its lower end extending into a trough O, the side walls of which ascend to a point a little above the lower end of the pipe N; so that when water is run into the trough, it rises inside the pipe K above the lower end of the pipe N, thus shutting off communication between the interiors of the concentric pipes. The trough is provided with a two-way cock P, having a connection Q leading to the base of the scrubber and a waste pipe R.

Manufacture of Coke and Gas.

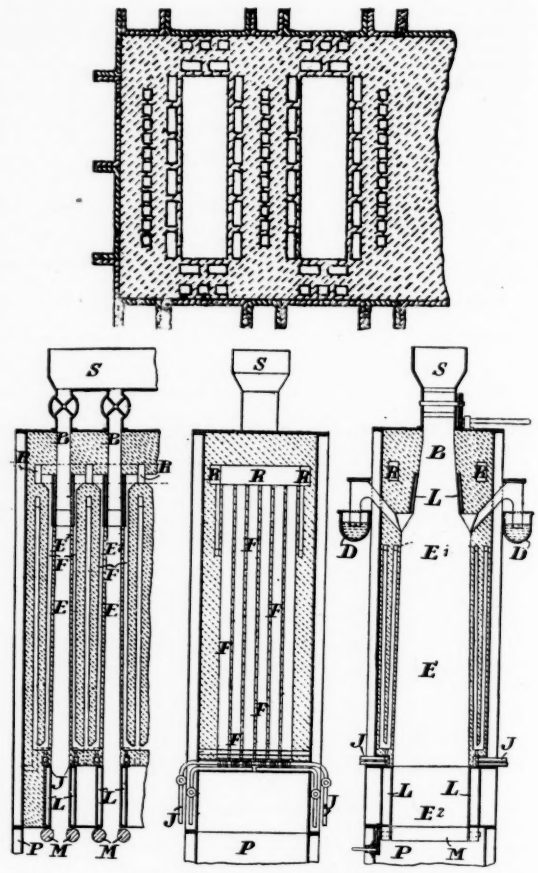
ARMSTRONG, J., of Lombard Street, E.C.

No. 1642; Feb. 15, 1906. Date claimed under International Convention, June 20, 1905.

This is an extension of the patentee's application No. 14,157 of 1904; his object being to manufacture "coke of a denser, more compact, and hard nature than ordinary furnace coke, and to be able to use in its manufacture coal or soft coke not generally used by present processes."

A horizontal section and three vertical sections of the plant are given. These show the plant, constructed of fire-brick, bound on the outside with iron plates strengthened by angle pieces. The structure is erected upon an air-tight chamber (either brick or metal) with at one or both ends air-tight fitting doors not shown; so that when the coke is discharged from above, it falls into waggons, periodically removed through the air-tight doors. The object of this air-tight chamber is to collect the coke and prevent access of air to the apparatus above.

The apparatus consists of perpendicular cells or chambers E, constructed in the upper part of fire-bricks, and made with walls tapering from top to bottom, so that the coke may descend freely. The lower part of the chamber is constructed preferably with water-jackets L and perpendicular heating flues F—running the whole height of the chamber. The flues are heated by gas, introduced by the pipes J. It is essential to have a high temperature in the lower portion of the chamber E, so the walls of the chamber are constructed very thin. The products of combustion are taken away from the top of the flues F by a main flue R to the chimney. The chamber is surmounted by a charging apparatus S, which supplies the coal in powder form through revolving apparatus actuated by gearing. The wings of the apparatus are perforated so as to allow the gas that fills the empty division as it ascends to get back again into the top of the chamber at B; otherwise at each revolution upwards of the compartments gas would be lost.



Armstrong's Gas and Coke Producer.

The apparatus is arranged to introduce the coal in small quantities at regular intervals, so that the surface of the coal is always at the level shown at E^1. The sides of the chamber at this point are formed of a water-jacket, to prevent the coking mass sticking, and thus arching, at this point. The chamber is also provided with exits for gas into the hydraulic main D, or these may be dispensed with, and the gas be drawn off at the bottom through the air-tight chamber P. By the first method, illuminating gas is said to be produced rich in hydrocarbons; by the second method, a non-illuminating gas is produced rich in hydrogen.

The theory of this method of working is thus set out by the patentee: In producing better dry coke and more gas than is possible by means of retorts, it is a well-known fact that under the retort system of gas production, where the feeding of the coal into ordinary hot retorts, within which it is spread out a few inches deep along the bottom of the retort, the gas comes in contact with the heated upper portion of the roof of the retort, where a disintegrating process goes on by which the heavy hydrocarbons are deposited in the form of retort carbon; while in some instances the hydrocarbons, which ought to be the illuminating portion of the gas, are given over in a condensable form as naphthalene, owing to the high temperature prevailing in the retort. On the other hand, the heat prevailing in retorts is not high enough to extract the whole of the gas from the coal within the time allotted, whereby a large quantity of a low candle power gas is lost. In the present invention, these two ends are obtained: First, in the distillation of the illuminating hydrocarbon at a low temperature, without the gas coming in contact with any highly-heated surface. The coal is systematically charged in small quantities into the cool region of the chamber E, which prevents the decomposition of the hydrocarbons, prevents the formation of naphthalene, and also prevents the decomposition of the ammonia in the gas. Secondly, a larger quantity of gas can be produced than is possible by means of retorts, because the region of high temperature commences immediately above the burners, and proceeds about half way up the chamber E. The products of combustion in the flues F lose their heat as they rise—thereby producing a cool region at the top of the chamber E, just where it is required for the distillation of hydrocarbons. But as this system is a continuous one, the coal undergoing distillation is continually falling by its own gravity down the chamber E, whereby it is gradually exposed to an increasing

temperature, until it attains the hottest regions, immediately above the heating burners. The temperature in this region being greater than is possible in retorts, the whole of the gas is expelled from the coal, "producing an increased quantity beyond that which is possible by means of retorts." The gas that is produced in the regions of high temperature will, however, be poor in illuminants; but considering the high illuminating power of the hydrocarbons distilled in the upper portion, when the two gases are mixed in the hydraulic main "a larger quantity of average illuminating gas is produced."

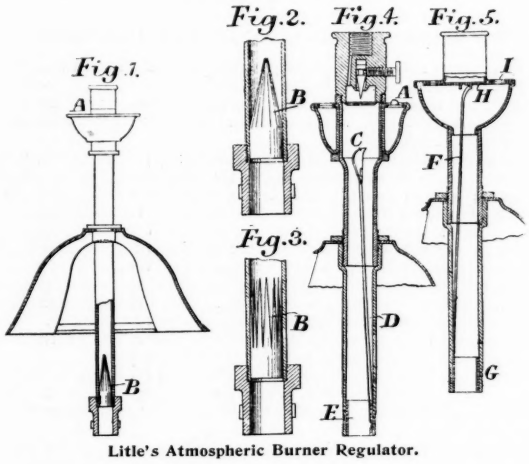
The high temperature prevailing in the second zone, combined with the pressure of the superincumbent charge in the upper regions of the chamber E, "produces a hard, dense, and superior coke to that which is made in retorts." When it has passed this region, the coke descends into the cooling zone E^2, which is surrounded by the water-jackets L. Here the heat is totally abstracted from the coke. On the bottom of these water-jackets rollers M are constructed, which revolve at a certain speed by suitable gearing, discharging the coke at a rate commensurate with the charging apparatus on the top, keeping the level of the coal inside the chamber.

Atmospheric Gas-Burners.

LITLE, T. J., of Gloucester City, N.J., U.S.A.

No. 6509; March 17, 1906.

This invention consists, broadly, in providing a thermostatic device which increases the relative proportion of air in the mixture during the normal operation of an atmospheric gas-burner, as compared with the proportion present at the time of ignition. It also consists in a thermostatic "impedance" which throttles the burner-feed when cold, but opens to reduce the "impedance" after the burner has been lighted. It further consists in placing a thermostatic device in the tube between the air-inlets and the burner-tip of an inverted burner.



Litle's Atmospheric Burner Regulator.

Fig. 1 is a vertical section of an inverted incandescence lamp constructed in accordance with the invention; figs. 2 and 3 are enlarged views showing the thermostat in closed and open position respectively; and figs. 4 and 5 are views of modified forms.

Referring to figs. 1, 2, and 3, the burner-tube having the burner-tip at its lower end, has in it, between the tip and the air-inlets A, the thermostatic "impedance device" B. This device consists of a cone of thermostatic material having a series of cross-slits extending through the apex. When cold, the cone has the form shown in fig. 2—the slits being partly open, so that the cone becomes a foraminous diaphragm, which operates to prevent flashing-back, both by reason of its foraminous character and by reducing the amount of air flowing in. After the burner is ignited, however, and begins to get hot, the thermostatic impedance opens until it assumes somewhat the form shown in fig. 3. In this form it is out of action, and allows the proper proportions of air and gas to flow to the burner tip, since the speed of the incoming gas current which draws in the air is not cut down or reduced by the device. Since air descends more freely through a cold tube than a hot one (since hot air tends to rise), the device reduces the amount of air at the time of ignition, and tends to allow the more sluggish current flowing down the hot tube to flow more freely through it. The burner is provided with the usual gas-valve and air-shutters regulated to suit local conditions.

The device for changing the proportion of air between the period of ignition and that of normal action may be varied in many ways. Thus, in fig. 4 the deflector C is carried by a thermostatic arm D secured to a thimble E within the burner. When cold, the deflector occupies the position shown, and obstructs the gas flowing down against it, so as to limit the amount of air drawn in; the result being that the burner feed is controlled in such a way as to prevent flashing-back. After ignition, when the burner-tube becomes hot, the arm shifts the deflector and moves it against the wall of the tube; thus allowing a freer down flow and proper proportioning of the gas and air for burning.

In fig. 5, the thermostatic arm F, secured to the thimble G, actuates the movable member H of the air-shutter I. This thermostatic arm is so arranged as to close partially the shutter when the burner is cold, and open it wider when it is warmed.

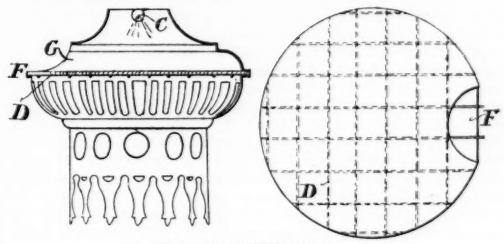
The patentee claims that by this arrangement the difficulty in flashing-back which occurs with inverted incandescence lamps is eliminated, and the proper air supply afforded at such times, as well as at times of normal operation; also that the impeding action of an ordinary foraminous diaphragm which gives rise to deposit of carbon on the mantle is avoided.

Automatic Gas-Igniter.

DEIMEL, F., of Berlin.

No. 6594; March 19, 1906.

This invention relates to an automatic gas-igniter in which a solid but porous plate is used for protecting the igniting body. This plate consists of a dense or compact material without perforations or openings of any kind, but of sufficient porosity to permit the passage of the mixture of gas and air to the igniter. Very thin plates of compressed fossil meal, unglazed china, or earthenware are particularly adapted for the purpose; but unperforated asbestos-paper can also be used provided it is sufficiently thin to be permeable to gas. Such plates retain the solid ingredients of the products of combustion, so that the igniter always remains clean and uninjured. Even if the flame of an incandescent burner flashes back to the nozzle, the soot and tarry substances are retained by it, as they are too large to pass through the pores.



Deimel's Self-Igniter.

The illustration shows a longitudinal section through a portion of a holder provided with the protecting plate, and the most suitable form of the latter.

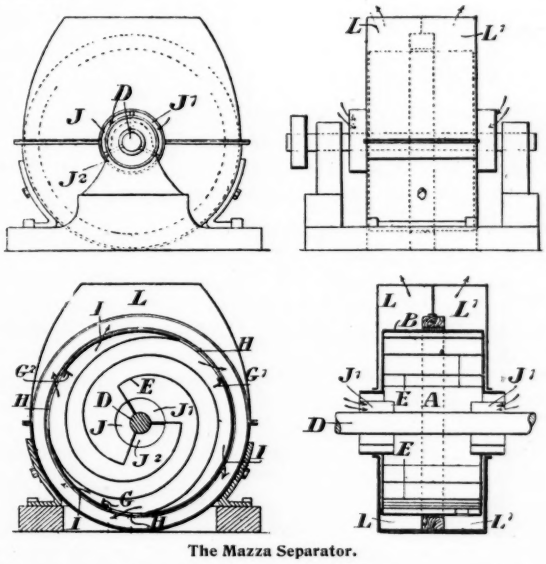
Upon the burner chimney bears the perforated lower part of any suitable form of holder, the upper part of which carries the igniter C. The protecting plate D is inserted between the upper and lower parts, and owing to its natural porosity permits the passage into the upper part of gas and air in such quantity as is required for ignition. In order to enable the flame to reach the burner orifice, the plate is provided with a lateral aperture F, not enclosed by the upper part—that is to say, it is not traversed by any straight line connecting the burner to the roof or walls of the part B; so that the gases of combustion rising through the opening G, provided in the upper part, freely escape without coming in contact with the igniter. In order to mechanically protect the porous protecting plate, a wide-meshed wire gauze is used to support the plate.

Separating the Constituents of Gaseous Mixtures.

MAZZA, E., of Turin.

No. 7421; March 27, 1906. Date claimed under International Convention, April 29, 1905.

This is an apparatus for separating the constituent elements of gaseous mixtures by centrifugal force produced by the rotation of a drum the interior of which is divided by diaphragms extending spirally around the axis of rotation.



The Mazza Separator.

The apparatus shown operates in the following manner: The shaft D, on receiving rotary motion, transmits it to the drum A and to the diaphragms E, which, acting in the manner of the blades of a fan, lower the pressure at the centre of the drum. Consequently, the gaseous mixture is drawn through the holes J, J^1, and J^2. Immediately the mixture has penetrated the drum, it remains imprisoned in one of the conduits formed by two successive diaphragms, and is submitted to a circular movement, which develops in the gases a centrifugal force constantly increasing until they reach the periphery. When the gases arrive at the points where the square of the tangential speed, divided by the radial distance from the axis of rotation, is sufficiently great, the

densest gases in the mixture are forced against the spiral surface furthest from the axis, leaving the lighter gases towards the interior. Consequently, the gaseous mass, which has traversed the course from the centre to the band B, meets the baffles G, G^1, and G^2, which compel the densest outer layer to pass out by the openings H, while the remainder of the fluid, forming the least dense layer, passes beneath the baffles and escapes through the other openings I. All the openings H debouch into the receptacle L, while all the openings I debouch into the other receptacle L^1. Thus "the constituent elements of certain gaseous mixtures, when separated by centrifugal action, may be recovered in different compartments of the fixed outer casing."

A similar result as regards the division of the gaseous mixture into its constituent elements could be obtained by employing a fixed drum and producing a difference of pressure between the inlets and the outlets. A current of gaseous mixture is thus set up through the spaces enclosed by the spiral diaphragms, which constrain the fluid to flow along circular paths; and this movement of the gaseous mixture submits it to centrifugal forces sufficiently powerful to bring about the separation of the elements of the mixture.

The gases separated in this way can be submitted afresh to several successive centrifugal operations in order to render the separation of the constituent elements of the mixture more complete and to purify each of them as much as may be necessary. Different proportions of oxygen and nitrogen, for example, may be extracted from the air according to the degree of centrifugation and the number of operations to which the air is subjected. That is to say, the air may be separated into two parts, whereof the one contains oxygen and the other nitrogen; and the quantity of gas eliminated in each of the parts may be diminished more or less. Hydrogen may be separated from carbonic acid gas and from mixtures of oxygen, from carbonic oxide, and from carburetted hydrogen. It is also possible to separate carbonic acid from its mixtures with oxygen, with carbonic oxide, and with nitrogen. Any cyanogen, carbonic acid, hydrosulphuric acid, and sulphurous vapours which may be contained in lighting gas, furnace gas, water gas, Dowson gas, gases of combustion, or even in the atmosphere, may also be separated therefrom (the patentee remarks) by means of the apparatus.

APPLICATIONS FOR LETTERS PATENT.

17,764.—Scott-Snell, C., "Burners for incandescent lighting." Aug. 7.

17,766.—Sensenschmidt, Max, "Burning off incandescing bodies." Aug. 7.

17,788.—Parkinson and W. & B. Cowan, Ltd., and Cheshire, W., "Injectors for gas-fire and other atmospheric burners." Aug. 8.

17,826.—Rott, P., "Valve apparatus for the supply of combustible gas and air to internal combustion engines." Aug. 8.

17,836.—Humphrey, A. H., "Gas-lamps." Aug. 8.

17,866.—Boylan, J. H., "Exhaust apparatus for gas-engines." Aug. 9.

17,867.—Wildbore, J. E., "Incandescent mantles, and stand for holding same." Aug. 9.

17,876.—Moeller, J., "Incandescent burners." Aug. 9.

17,905.—Read, F. W., "Treatment of minerals or compounds of the alkaline earth metals for the recovery of useful products." Aug. 9.

17,910.—Lemon, R. F., and Freel, H., "Generation and purification of acetylene gas." Aug. 9.

17,936.—Wilkinson, J. H., "Acetylene lamps and generators." Aug. 10.

17,976.—Deimel, F., "Igniters with filaments." Aug. 10.

17,999.—Meyer, A., and Hastert, E., "Cooling and purifying gases." Aug. 10.

18,009.—Mouhlen, J., "Cocks for controlling the supply of water to domestic or similar service pipes and taps." Aug. 10.

18,014.—Meyer, A., and Hastert, E., "Cooling gases." Aug. 10.

18,019.—Cressey, C., "Lighting street-lamps." Aug. 11.

18,024.—Warry, J., and Arculus, G. N. & E. A., "Incandescent gas-burners." Aug. 11.

18,033.—Rehmann, H., "Charging furnaces and gas-generators." Aug. 11.

18,039.—Keith, J. & G., "Inverted incandescent gas-lamps." Aug. 11.

18,043.—Boult, A. J., "Gas-burners." A communication from the National Gaslight Company. Aug. 11.

18,081.—Becker, H., and Greener, O. T., "Gas-producers." Aug. 11.

18,152.—Van Vriesland, A. I., "Incandescent gas-mantle" Aug. 13.

18,165.—Terrell, T., "Treatment of ramie and other like fibres." Aug. 13.

18,196.—Hughes, G., "Condensers." Aug. 14.

18,197.—Harris, A. C., and Ionides, A. G., "Delivering either measured quantities or giving a continuous flow of liquid from any supply system." Aug. 14.

18,216.—Klein, R., "Liquid meters." Aug. 14.

18,256.—Clark, W., "Water-gas producers." A communication from the Dellwik-Fleischer Wassergas Ges. m. b. H. Aug. 14.

18,257.—Sibley, J. E., "Anti-vibrator for incandescent gas-lamp." Aug. 14.

18,330.—Nehmer, H., "Electrical apparatus for lighting gas." Aug. 15.

18,430.—Head, B. W., "Charging, and drawing charges from, furnaces and analagous operations." Aug. 16.

18,460.—Broadhead, J. B., "Regulating pressure in pipes." Aug. 17.

18,505.—Feld, W., "Treatment of gases for the extraction of ammonia." Aug. 17.

18,511.—Cahill, D., "Liquid meters." Aug. 17.

18,512.—Bendel, J., "Treatment of ramie." Aug. 17.

18,513.—Cahill, D., "Liquid meters." Aug. 17.

The Mid-Sussex Natural Gas and Cement Company, Limited, has been registered with a capital of £10,000, in £1 shares, with the object indicated by the title. There will be no initial public issue.

CORRESPONDENCE.

[We are not responsible for the opinions expressed by Correspondents.]

Some Recent Gas Company Flotations.

Sir,—With reference to the vigorous attack made by Mr. H. E. Jones, at the general meeting of the Wandsworth Gas Company, on bogus gas companies, I might state that I have some acquaintance with several small companies which have not been altogether free from the attentions of philanthropic company-promoters.

Their first step was to write boldly and ask at what price my friend would be willing to sell. This, producing no effect, was followed by a request for a price, as a small gas-works was needed for some experimental work. The nature of this work did not transpire; but if one suggests that the experiments were to be made on the gullibility of the British public, it may be imagined that we should not be far wrong.

Now my friend is being asked for a list of the shareholders, and an ultra-polite postscript informs him "the cost of which we shall be happy to pay." Neither that happiness nor the list has been vouchsafed to them.

I presume that wherever there is a flourishing industry, there, on the outskirts, you will find some hangers-on whose works and reputation are hardly such as would recommend them to honest men. The unfortunate part of the whole business is that these gentry are occasionally successful. How long will foolish shareholders be content to act as their milch cows? An ancient philosopher said that mankind was made up of two classes—knaves and fools. At the present day, extinction seems to threaten neither class.

10, *Arthur Street West, E.C., Aug.* 27, 1906. H. L. Johnson.

Mr. Anderson's Address to the Irish Association.

Sir,—Averse as I am to writing to the Public Press, even to the Technical Press, I do not consider it right to pass without notice the (anything but complimentary) allusions to Wexford, which Mr. R. B. Anderson thought well to make several times in the course of his address to the Irish meeting.

I have delayed writing for two reasons: (1) Having seen Mr. Anderson's name so frequently within the last two or three years in connection with matters of little or no importance, in your columns and in other papers devoted to the gas industry, I had doubts about taking him seriously; (2) I waited to see a full report of the Irish meeting [I am not a member] in your number of the 21st inst., lest there should be any further misstatements about Wexford.

I may now be permitted to say something about the object, position, and policy of the Wexford Gas Company. The Company was started as a Consumers' Company, and remains so in fact to this day. Many of the largest consumers are shareholders, and a few of them are Directors. All the shares are held by Wexford people.

The policy of the Company has been from its inception to sell gas at as low a price as possible, while maintaining a good dividend. This policy has been successfully carried out, and is likely to be continued.

The gas consumers of Wexford have had lower prices for gas for at least 35 years than any other town of equal size in Ireland. The present low price is of no small advantage to the community at large. There are some rather important industries in Wexford, and successful ones too. The price at which gas is sold is of no small help to these industries. It is also a help to the traders of the town.

Mr. Anderson has stated that the Wexford Company cannot go on paying its dividends unless gas is sold at a lower price than in either Cork or Dublin. The price of gas has been lower in Wexford for about 20 years than in either of the place named; and if it ever should be advanced, through increased prices of coal or other cause, then it is likely that the prices in Cork and in Dublin would also be higher than they are now.

The present price at Wexford could be advanced 7d. per 1000 cubic feet (a good margin, one would think) without any diminution of dividend; and the price of a large proportion of the gas which is now being sold at from 2s. 3d. to 2s. 6d. per 1000 cubic feet could, of course, be raised. The price has been reduced since the Provisional Order was obtained.

I cannot help thinking that Mr. Anderson is more afraid that there may be a further reduction in the price at Wexford; and, if so, there may be some grounds for his having such fear. In reducing the price of gas from time to time, justice to the gas consumers who contributed to the profits was borne in mind, and not popularity, as Mr. Anderson insinuated.

In speaking of the Wexford Provisional Order, he is very much mistaken, as only two gas consumers—and those not large ones—took an active part in the opposition as far as it went. The Board of Trade official who held the inquiry, after hearing the evidence of two witnesses on behalf of the Company (not a single witness being examined for the Corporation), decided in favour of the Company. They got practically all they had asked for, with but one small concession on their part.

Mr. Anderson coolly states "and rather than lose its Order [Wexford] agreed to terms which, I fear, will make it exceedingly difficult to raise any of the small amount of additional capital allowed to it." Now, this is a gross misstatement, to say the least of it. The Company, as I have said above, were granted all they had demanded, except that some reduction of the proposed capital was made and a small concession as to meter-rents, which are not charged now, and have not been charged for close on 40 years, nor are likely to be. Much of the new capital has been raised since then; and all of it could be raised, without delay, in Wexford, if required. The position of the Wexford Company is so safe—enviably so, perhaps—that any money that should be required, can be had freely at any moment at 4 per cent. or less.

The same Board of Trade official visited Tipperary the day after the inquiry at Wexford, to hear what Mr. Anderson had to say on behalf

of the proposed Provisional Order for Tipperary; and having fresh on his mind the low price of gas in Wexford, and the prosperity of the Wexford Gas Company, there was not the least chance of Mr. Anderson getting his Order, and it fell through. No wonder that he considers Wexford as a thorn in his side; though, it is needless to say, it has never been the aim of the Wexford gas undertaking to be a thorn in the side of anyone.

In his remarks about Wexford in different parts of his address, Mr. Anderson never had the fairness, or the candour, to give credit to Wexford for good management; and when I say "management," I include the Directors as well as myself. Readers of this letter will kindly bear in mind that I say this much about the management with very great reluctance, and what I have said as to it has been confirmed on the high authority of Mr. Charles Hunt, as can be seen by reference to your "JOURNAL" for April 21, 1903, p. 163.

Mr. Anderson is "chagrined to find that companies, with which he is connected, do not sell gas so cheaply as other towns of similar populations." It is wonderful that his prices should be so high, with all the benefits he has claimed for associated management!

A further reference to the rejected Provisional Order for Tipperary discloses the fact that he was prepared to make a substantial reduction in the price of gas if he got the Order. Not having got it, he coolly declares, on a public platform, that—by way of punishment, of course—he would allow the old price to stand. What can gas consumers expect from such a man as this? If I were a gas consumer in Tipperary, I would not, after having read this declaration deliberately and publicly made, consume another cubic foot of his gas.

He has attempted to account for the comparatively high prices in towns with which he is connected—especially those outside of Waterford—by stating that the low valuation per unit of population is the cause. He has found on going over figures that Wexford (that "thorn in the side of every Southern gas manager") is, according to him, the one exception. The exception proves the rule, Q.E.D.

Doubtless, it has occurred to many of your readers that this is extraordinary reasoning on his part. It would hardly hold good even if Wexford were the only exception. But, as I will show, there are several exceptions, and his argument is baseless. Your readers could see these many exceptions at a glance, had he given the price of gas per 1000 cubic feet side by side with the valuation per head. But this he has not done.

He also hinted that the price of gas was a question of North and South—of temperament; but he did not dwell much on that possible cause. I think I might be permitted to refer to the case of Wexford, which is certainly in the South, and where, as Mr. Anderson had to admit, "the price of gas is practically the lowest in Ireland"—taking into account, of course, its comparatively small production, and small population, as compared with Belfast.

Here are some of the other exceptions to the "Bruce Anderson Formula," shall I say, for dear gas and cheap gas: (1) Queenstown, the port of Cork, with splendid harbour and low freights, having an annual production of over 20 million cubic feet, and a valuation of £2·9 per head, charges a higher price for gas than Tralee, with a poor harbour and higher freights. (2) Galway, with a good harbour and low freights, valuation £2·1 per head, annual gas production 10½ millions, charges 5s. 6d. per 1000 cubic feet for gas, as against 5s. charged by Killarney with only an annual production of 6⅓ millions, valuation only £1·7, and coal carried by railway for 60 miles in addition to the freight by sea to Cork. According to the "Bruce Anderson Formula," and the other well-known and accepted rules, the price of gas in Galway should be cheaper than at Killarney. (3) Dungarvan, a seaport town with good harbour and moderate freights, valuation £1·7, annual production 6 millions, charges 6s. 3d. per 1000 cubic feet for gas, as against Cashel, a little town almost in the centre of Ireland, with an annual production of only 2½ millions, which charges only 5s. 10d., valuation of Cashel £1·3. As above, the price of gas at Cashel, especially according to the "Bruce Anderson Formula," should be higher than at Dungarvan.

I could give many other exceptions, showing the unsoundness of the above formula; but I shall content myself with two more: (4) Portrush, a seaport, in the extreme North of Ireland, with a high valuation of £5·8 per head, annual gas production 6 millions, charges 5s. per 1000 cubic feet for gas. (5) Gorey, an inland town in Co. Wexford, using about 280 tons of coal in the year, producing about 2⅓ million cubic feet of gas, charges only 5s. per 1000 feet—the same as Portrush with its high valuation and its production of more than double the quantity of gas. The valuation of Gorey is only £1·6 per head.

I shall now apply the "Bruce Anderson Formula" to this by simple proportion: Gorey, with a valuation of £1·6, can sell gas at 5s. Therefore Portrush, with a valuation of £5·8, should sell gas at 1·39s. Now apply the formula to Wexford and Portrush: Wexford, with its plebeian valuation of £1·6 per head, sells gas at 2s. 9d.; what should be the price in Portrush with its princely valuation of £5·8 per head?

As £5·8 : £1·6 :: 2s. 9d. : 0·75s.

Answer = 9d. per 1000 cubic feet.

Be it remembered that Wexford is in the South of Ireland and Portrush in the North; and the only way to account for it is that "Wexford is—well, Wexford," and Portrush is—well, Portrush.

There are many other things in the address which could be sharply criticized; but as they do not concern me I pass them over, except this: Mr. Anderson appears to find a difficulty in getting suitable mechanics in Ireland. I have had no such difficulty. All mechanics—nine in number, permanent, besides occasional men—are local men, with two exceptions; and the latter are like the others, Irish. All were trained at the Wexford works.

I really regret having to trouble you with this long letter.

Wexford, Aug. 23, 1906. JOHN LYNE.

Sale of Taunton Gas Company's Stock.—At a sale recently conducted by Messrs. Joseph Darby and Co., at Taunton, seven £5 shares and £7 of 5 per cent. stock of the Taunton Gas Company were sold for £59, £60 of consolidated "A" stock for £105, and £55 of similar stock for £99.

MISCELLANEOUS NEWS.

LIVERPOOL UNITED GASLIGHT COMPANY.

A Record Consumption.

The Annual General Meeting of this Company was held on Tuesday last—Mr. H. WADE DEACON in the chair.

The SECRETARY (Mr. P. F. Garnett) having read the notice convening the meeting, the report and accounts for the year ending the 30th of June were presented. They showed that the total revenue was £594,830, and the expenditure £487,555; leaving a surplus of £107,275, which was transferred to the credit of the profit and loss account. After deducting the amount taken for payment of the dividend declared last February, and the interest on the debenture stock, there remained a balance of £65,975, out of which the Directors recommended the payment of a dividend for the past half year of 5 per cent. on the ordinary consolidated stock, and 3½ per cent. on the 7 per cent. "B" stock.

The CHAIRMAN, in moving the adoption of the report and accounts, said the affairs of the Company were in a most satisfactory condition. They had had a very successful year as regarded the manufacture of gas. The consumption had been nearly 3 per cent. larger than in the preceding year; and the total quantity of gas sold had been a record in the history of the undertaking. It was also satisfactory to note that the increase had been general throughout all classes of consumers. This showed that gas was holding its own to a large extent against all competition, and was increasing in use not only for lighting purposes to some small extent, but was also increasing rapidly in the directions of heating and power. The users of automatic meters possessed an advantage which the ordinary consumers had not, of having stoves supplied by the Company at a very low rental; and the Directors were glad to see that this was greatly appreciated. They had now upwards of 9000 stoves in use, and there was still a steady demand for them. The stoves were a blessing to the people who used them, especially in the hot weather; and they were also a blessing to the Company, because they helped the sale of gas. In respect to the accounts, there was no change in the stock and loan capital; but on capital account there was an addition of £6524. The Directors tried to increase the capital as little as possible; and this was the lowest they could make it for the year. The revenue account was the most interesting. The total cost of gas manufacture had been £373,755, against £374,815 the previous year. In other words, while they had made more gas, the total cost of manufacture had been less. This was a reduction of £1060. It was not very much to boast of, but it was in the right direction. It would have been apparently larger, had not the cost of repairs and maintenance been so high. Last year they spent £71,000, compared with £68,000, which was a considerable rise. The extra cost of labour had decreased by £3000, which was extremely satisfactory. For some years past the Directors had spent large amounts in maintenance and repairs, in the hope that by doing so they would reduce the cost of production. He was glad to say that already they had felt the benefit of the expenditure; and he had not the slightest doubt that in future they would reap still further advantage. The cost of production was being reduced by the introduction of better appliances for the handling of coal. They were also reducing the heavy manual labour so common in gas-works. By means of their improved apparatus, they were reducing this heavy labour to a minimum; and he hoped by degrees they would reduce it still more. This, he thought, would commend itself to everybody, especially as at the same time they were lowering the cost of manufacture, which was the main object of the directorate. By this means, they hoped to hold their own in the competition of the electric light. The cost of distribution had increased to the extent of £3250. This was simply because more work had been done, and the amount of renewals had been rather greater than the preceding year. Rates and taxes had increased by £2191. The total was now £26,682—rather more than 2d. per 1000 cubic feet; so that the rates and taxes were pretty heavy. The total expenditure was £487,555. On the other side of the account, the income had been less than it was the previous year. This, of course, was expected, because twelve months ago the price was reduced from 2s. 8d. to 2s. 6d., and naturally the income was smaller. He was glad to say, however, that the net result was almost exactly what the Directors anticipated. The sale of gas had yielded £12,026 less than the previous year, which was entirely due to the reduction in price. The rental of meters and stoves had both increased, and amounted together to £551. This was a significant fact. The demand for meters was still increasing. Residuals had yielded £3493 less than the previous year. Last August he stated that they could not expect to receive as much for residuals during 1906 as they had in 1905, and the result had proved that the Directors' anticipations were correct. He hoped they might do a little better this year, although the price of residuals was still extremely low. The result of the year's working was a total income of £594,830; and after deducting the expenditure of £487,555, there was a balance of £107,275 to be carried to the profit and loss account. To this balance had to be added £78,072 brought forward from the previous year, making a total of £185,347. From this had to be deducted debenture and other interest from June 30 last, and two half-yearly dividends paid in August, 1905, and February last; leaving a balance of £65.975 (subject to this half-year's dividend) to be carried to the next year's account. This result was almost exactly what they anticipated; and, considering the large reduction in price, he thought it was exceedingly satisfactory. The reserve fund account had been increased by £3109, the amount of interest and dividends received. The Directors had had a careful estimate made for this year's working, and they did not see their way to reduce the price, nor did they think it necessary to increase it. They had bought their supplies of raw material at about the same figure as before; and, on the whole, they thought this year's working would produce a satisfactory result.

Sir EDWARD LAWRENCE seconded the motion; and it was carried.

Dividends as recommended in the report were then declared; and the proceedings closed with the customary votes of thanks to the Chairman, Directors, and staff.

CROYDON GAS COMPANY.

The Half-Yearly General Meeting of this Company was held last Friday, at the Croydon Art Gallery—Mr. CHARLES HUSSEY, J.P., in the chair.

The SECRETARY (Mr. W. W. Topley) read the notice convening the meeting. The Directors' report and the accounts were taken as read.

The CHAIRMAN, in moving the adoption of the report and accounts, said his first duty must be the pleasant one of congratulating the proprietors on the very satisfactory state of affairs disclosed. Whether they regarded the half year from the point of view of increase in sales of gas, increases in numbers of consumers and of stoves on hire, or profits made, it ranked among the best the Company had had for some time past.

CAPITAL EXPENDITURE.

From the accounts, the proprietors would have seen that a fairly large sum—£13,239—was again shown as expended under the head of capital on works and plant. It might interest them if he briefly mentioned the directions in which this had been spent. A considerable proportion had been expended upon the enlargement of the chief offices in Katharine Street. These were making good progress; and the Directors hoped to have been able to have met the proprietors there that day. This could not be done, however, with any comfort; and it was therefore thought better to defer meeting in them until the proprietors could have an opportunity of seeing the new buildings in a finished condition. The offices would then, he believed, be among the most complete, and best adapted for their purpose, in England. The new stove-repairing shops and stores at the works had been completed during the half year; and their formal opening by Mrs. Helps, the wife of their esteemed Engineer and General Manager, was recently the occasion of a very pleasant gathering of the Company's employees. Shortly, they would be in full work; and the Company could count upon the large amount of work they had to do in the department being then accomplished not only much better, but more economically than in the past.

THE IMPORTANCE OF THE COOKER.

The importance to gas companies of the business done in hiring out cookers could hardly be exaggerated. As would have been seen, they had increased the number on hire by nearly 1000 in the half year. The rapid growth half year by half year in the number of cookers was telling on the consumption of gas, as the proprietors would understand when he told them that, during the eight weeks of hot weather since July 1, the increase in the output over last year had been about 14 per cent. The sale of gas for cooking was particularly profitable to the Company, inasmuch as it represented the use of gas in the day, when otherwise the distributive system would be more or less idle, and as it tended to increase the output in the summer months, and thus make the plant at the works more evenly productive of profit all the year round. They had now over 14,000 cooking-stoves in use in the district; and if it were borne in mind that each of these represented cooking done by gas, instead of by coal, the Company might, he thought, claim that, by helping to lessen the quantity of smoke emitted from house chimneys where coal was used, they had done, and were doing, something not inconsiderable to increase the comfort of life in the town.

DIMINISHING MANUFACTURING COSTS.

Good progress had been made with the construction of an entirely new section of works on the additional land acquired some time ago. In this connection, perhaps the chief feature that stood out in the half-year's experience was the remarkably low cost of manufacture of gas. As against last year, coal had cost slightly more, and oil rather less—one about balancing the other—and yet they had been able to make gas at Waddon at a gross cost of nearly 2d. per 1000 cubic feet less, or some 9 per cent. cheaper. This had been due in great measure—and the Directors fully recognized this—to the constant and able supervision which had been exercised, and to the careful working of the plant. But this care could not have produced the results named without the aid of the modern and improved carbonizing appliances that had been installed. This was the first half year in which their Engineer had been able to work entirely with the new retort-house; and the results were such that the Directors were, and he might well be, highly pleased. As he had said, they were proceeding with the erection of a new section of the works; and when it was set to work, attention would be given to modernizing the older portion of the works.

CAPITAL ISSUES—A MAXIMUM DIVIDEND STOCK.

As a consequence of their continued expenditure in these remunerative directions, it had been necessary to raise a good deal of capital. As the proprietors would see, they had raised nearly £27,000 in the half year—the greater part in the form of premium capital. They were arranging for an issue in October of £20,000 "D" stock by way of tender. This was the first issue of this kind of stock, the power to create which was given to the Company by Parliament in 1904. It was a stock carrying a maximum dividend of 5 per cent.; and as its price of issue would therefore approximate more closely to its nominal amount than was the case with their "A," "B," and "C," stocks, the Directors, having regard to the general experience in this direction, expected to be able to raise it on terms favourable to the Company. It was a denomination of stock well suited to the needs of the small investor, who could put his or her savings in it in sums of £5 to £6 and upwards. The Board hoped that many of their consumers would avail themselves of the opportunity to acquire an interest in the Company, and thus share in the profits their use of gas assisted to realize.

NEW PROMOTIONS AND THEIR PROSPECTUSES.

In this connection, it might not be amiss if he referred to some regrettable financial incidents of the last year or so. He meant the flotation of companies to acquire small gas undertakings at high prices, and the issue to investors of misleading prospectuses. The stocks and shares of established gas undertakings such as their own had long been favourably regarded by investors; and good gas securities offered an investment that, if regard be paid to percentage returns in relation to stability and security, ranked deservedly high. In the main, issues of capital by gas undertakings deserved the confidence they were regarded with. But unfortunately the professional company promoter had, in some few instances, endeavoured to trade upon this confidence; and in the last year or so, there had been formed several gas companies the prospects of whose shareholders were far from reassuring. He mentioned this to emphasize the point that some prudence and discrimination should be exercised by investors before applying for shares in newly-formed gas companies. It should not be hastily assumed that because the industry was a highly profitable one for established undertakings in towns and thickly populated districts it would of necessity be equally profitable in all places.

THE REVENUE ACCOUNT.

Turning now to a more pleasant topic—the revenue account for the half year, to the very satisfactory manufacturing results he had already referred. There was not much else on the expenditure side to which he need draw attention. The amount under the head of "Repairing and Renewing Meters" was rather heavy; and the explanation of this was that they had, in the half year, thrown out of use a number of small meters, known as "three-lights," and had substituted larger ones for them. This was a consequence chiefly of the increased use of gas for cooking by the smaller consumers. There was also an increase under the head of "Public Lighting." This was due to the replacement of a large number of old lanterns by lanterns of improved patterns more suited for use with incandescent burners. In connection with street lighting, it was not uninteresting to note from the Press that a comparison which had been made by the Beckenham District Council of the costs of incandescent gas lighting and electric arc lighting showed the latter to cost ten times as much as the former for the same length of street, or £570 per mile per annum for electric arc lighting, against £57 per mile per annum for incandescent gas. This was in practical agreement with the results which had been found to obtain in Croydon. Doubtless the gas lighting would have to be on a rather more costly scale than it was to give quite the same amount of light as the other; but there was little doubt that in Beckenham, as in Croydon, the streets could be lit in every way as well by gas as by electricity, at not over one-half the cost. On the "Receipts" side of the revenue account, there was a substantial increase from the sale of gas—nearly £5000, notwithstanding the gain to consumers in the Caterham district of over £550 through the lower prices at which gas was sold by the Company than was formerly the case there. The number of consumers was steadily growing; and it was satisfactory to the Directors that, as a result of calls made by the Company's inspectors at houses where gas had been supplied in the past, many of the additional accounts were with new tenants, who did not trouble to arrange for a supply of gas till called upon by their inspectors, although the necessary pipes were in the houses. Six months ago he stated there were indications of improving markets for coke; and he was glad to say the expectations formed of better results from this residual had been fulfilled. So far as they had gone this half year, the improvement in price was not only maintained, but increased; and they had effected a sale for the ensuing year of part of their make at a price considerably above the present value. In addition to the better prices obtained, they had gained in the way of having more coke for sale from the very good manufacturing results he had already spoken of. The contracts both for coal and oil for the coming twelve months were (as in the case of other gas companies) at higher prices than a year ago; and the extra amount they would have to pay in this direction during the current half year would not fall far short of £3000. But a good portion at all events of the increase they hoped to get back from the higher price of coke. They had done slightly better with tar; but the markets for sulphate of ammonia had not been quite so favourable as last year.

THE FINANCIAL RESULT.

The net result of the half year was that, after writing off £500 in respect of the old Carshalton works, and after including in the charges to revenue £1250 in respect of buildings pulled down to make way for the extensions going on at the works, they had £24,761 left as gross profit for the half year, or £4831 more than the combined gross profits of this and the Caterham Company a year ago. From the gross profit, the Directors had placed a further sum of £1000 to the renewal fund, in view of the charges that would be thrown on the fund shortly in connection with the remodelling of Nos. 1 and 2 retort-houses. The outcome was a balance available for dividends of £24,381, leaving, after the payment of dividends, a carry-forward of £4527, or nearly £1000 more than came from last half year. This, he thought, every proprietor would consider satisfactory.

The DEPUTY-CHAIRMAN (Mr. Thomas Rigby) seconded the motion, which was unanimously adopted.

DIVIDENDS—SHAREHOLDERS' AND CONSUMERS'.

Mr. WILLIAM CASH moved a resolution declaring dividends at the following rates per annum, less income-tax: 14½ per cent. on the "A" stock; 11½ per cent. on the "B" stock; 10¾ per cent. on the "C" stock; 5 per cent. on the "D" stock; and 10 per cent. on the "E" stock. He remarked that, after the admirable speech they had listened to from the Chairman, giving in detail the results of the half year, no words were necessary to recommend this resolution to the approval of the proprietors. These dividends might appear to the outside public to be rather large; but he should like to draw attention to this fact, that since 1877—that was, for the last thirty years—the whole of the capital issued had been raised under the auction clauses, and therefore the greater part of the proprietors who were receiving these dividends were obtaining only a moderate return on the capital they had invested in the Company. The dividends had been slightly progressive; but the return was only something like 4½ per cent. on the capital that had been raised over that period. The best test of this was to take the cost per 1000 cubic feet of gas for dividend and interest, which was part of the cost before the gas was

used by the consumers. The cost per 1000 cubic feet eleven years ago was 12·33d.; but by June last it had dropped to 10·05d., or but little over 10d. per 1000 cubic feet. This proved another thing, that the capital the Directors had been spending during the last few years had been highly remunerative to the shareholders, while it had also worked to the advantage of the consumer, who was getting gas cheaper than he was at the beginning of the period. This resolution was usually proposed by Mr. Corbet Woodall, who had asked him to say how sorry he was that he could not be present at the meeting. That afternoon he had attended the Board meeting; but another engagement compelled him to give up the pleasure of being present at the shareholders' meeting.

Mr. PERCY H. HALL seconded the motion, which was unanimously carried.

A SHAREHOLDER ON NEW FLOTATIONS.

Mr. A. W. OKE moved a hearty vote of thanks to the Chairman and Directors. He spoke approvingly on many features that had been brought out by the Chairman. Regarding the issue recently of prospectuses of small gas companies, he said it made his heart ache to receive some of the circulars. These documents were got up in such a specious form, that it might have been thought the promoters were offering to the public one of the best investments that had ever been placed before them. As a shareholder in a large number of gas companies, he must have had a copy of these various prospectuses through each of the companies in which he held shares. He believed on one occasion he received twenty a day. Some of the people who had invested in this class of company would rue the day they had anything to do with them. He was pleased to hear the Chairman warn the shareholders of this Company, and the public generally, against this new class of promotions.

Mr. C. E. BOTLEY said he had pleasure in seconding the proposition of Mr. Oke, with whose remarks he entirely agreed. After considerable experience in gas administrative matters, he could say with confidence that, successful as most gas companies were, he knew of no company that had a brighter future than Croydon.

The motion was unanimously carried.

BE WATCHFUL!

The CHAIRMAN, in the course of his reply on behalf of himself and his colleagues, said he was very pleased to hear that Mr. Oke approved of the remarks he (the Chairman) had made respecting some of the prospectuses that had been issued. It had not been the wish of the Board to disclose the names of their proprietors when they knew something about the origin of certain gas companies; it was not the wish of the Board that these circulars should be distributed among them. But the Board took the opinion of their Solicitor; and they had no choice. Therefore they had with regret been obliged to furnish the names. He had simply drawn the attention of the shareholders to the matter so that they could be on their guard with respect to prospectuses that might be issued in the future. He would not say that all new companies were going to be of the same class; but what he did say to the proprietors was—"Be Watchful." He then moved a vote of thanks to the officers, their staffs, and the workmen, for their efficient services during the past year. In turn, the Chairman commented on the services of their Engineer and General Manager (Mr. J. W. Helps), of the Secretary (Mr. Topley), of the Assistant-Engineer (Mr. A. Caddick), and of Mr. Sandeman, the Distribution Superintendent. As to the workmen, they were happy under the conditions that existed. They felt that the Directors took a real interest in them; and in return the Company received their best services.

Mr. SAMUEL SPENCER seconded the motion, which was unanimously carried.

GROWING IMPORTANCE OF THE DISTRIBUTION DEPARTMENT.

Mr. HELPS made a sincere acknowledgment of the vote. In the course of his remarks, he said the Chairman had alluded to one of the reasons of the satisfactory balance-sheet, when he said it was due partly to the great care and supervision that had been exercised at the works. He (Mr. Helps) accepted that. He believed that great care had been exercised; but it would not have sufficed to have brought about these results if it had not been for the hearty and loyal co-operation of every member of the staff and workmen at Croydon. The results they had obtained, too, were due to the great efforts that had been made by the distributing staff. It might surprise some of the proprietors to know that, whereas the district staff at one time bore a very small proportion in relation to the men making gas, so greatly had the work of this department increased that he thought he would not be far wrong if he said they now employed nearly as many men in the distributing department as in the manufacturing department. The expense of the department had in late years been very largely increased. He should like to allude to the reason for this. In (say) 1889, just before they started the prepayment system, their consumers used to burn on an average about 55,000 cubic feet of gas. Since they had brought in a large number of prepayment consumers, and since the advent of the incandescent light, the average consumption had been brought down to 33,000 cubic feet. It would therefore be seen that the distribution department had to deal with far more consumers than in years past. In the last ten years, too, while their amount of gas had practically doubled, the number of consumers had trebled, and the number of stoves on hire had quadrupled. It would therefore be seen that the work they had to do in dealing with a certain quantity of gas was far greater now than it was some years ago. This would show why the amount of money spent in the distribution department was now so much more than it used to be. It was largely due to the distribution department that the results were so successful as those the Board had presented to the proprietors that day.

Mr. TOPLEY also thanked the proprietors, on behalf of himself and his staff, for the generous recognition of their services.

This concluded the proceedings.

New Reservoir for the Weardale Water Company.—The Weardale Water Company have erected a supplementary reservoir on Findon Hill, Sacriston, with a holding capacity of 125,000 gallons, or exactly half that of the old reservoir.

BOURNEMOUTH GAS AND WATER COMPANY.

The Ordinary General Meeting of this Company was held on Friday, at the London Offices, No. 90, Cannon Street, E.C.—Mr. G. CRISPE WHITELEY in the chair.

The SECRETARY (Mr. William Cash, F.C.A.) read the notice calling the meeting; and it was agreed to take as read the Directors' report and the accounts.

The CHAIRMAN, in moving the adoption of the report and accounts, remarked that modern custom seemed to require an address from the chair at meetings of all companies. In some large undertakings where the meeting was an annual one, he could understand an address might be of some considerable importance. But with an ordinary industrial company, where they proceeded year by year in the "even tenour of their way," and had to meet the shareholders, or such of the shareholders as liked to attend the meetings, every six months, it was somewhat difficult to give an address that might be of equal importance. But they had now over 1000 shareholders; and he was enabled, through the publication of the report of the proceedings, to communicate to them all—indirectly, if he was not able to do so by word of mouth—a few of the salient points of the six months' working that might be of interest. With regard to the accounts, they were in a transition state somewhat; owing to the fact that they were having very heavy expenses in connection with the new works at Poole on the one hand, and, on the other, they were not yet receiving the full benefits they hoped to gain by the new works when they were completed. This would account for the profit and loss account not being so flourishing as some of those for previous half years, as well as from the fact that there was a reduction in the carry-forward. When he had said this, and when he had drawn attention to the fact also that the Company, like all other gas ventures, had not been so flourishing with regard to residuals, he had, he thought, brought to notice everything that, under the circumstances, could be said on the adverse side of their working. Everything else was a source of congratulation, and of very complete congratulation, as to the way in which the affairs of the Company were going on at Bournemouth. They were declaring what he was always pleased to call their usual dividends; they were placing to reserve what he was generally pleased to call the usual contribution; and, in addition, they were carrying out the plan decided upon a short time ago, of writing off £3000—in other words, at the rate of £6000 a year—the value of the old works at Poole, which were taken down to make way for the new ones. This was somewhat heroic finance; but he was sure it was fully justified under the circumstances, and would, he trusted, meet with the approval of the shareholders. He had the honour to belong to a profession which lived mainly—though not entirely—upon litigation; and therefore he had been extremely careful, as a member of the Board, to try to keep the Company out of legal fights as much as possible. During the past half year, through no choice of the Directors, the Company had had contests both before Parliamentary Committees and in the Law Courts; and they did not go to either place of their own accord. He could not resist the temptation of congratulating the shareholders upon the Company being on all hands victorious. The Poole Corporation Bill would have done the Company some serious harm if it had been passed in the form in which it was introduced. The Directors were therefore bound to oppose it. The contest was what was called a friendly one; and he should like to recognize the generous and chivalrous way in which the Directors were met by the Poole Corporation. At the same time it was a contest. This being the case, they were very glad to be able to maintain all the points for which they were contesting; and they would now continue to supply the whole of the area within which they had distributed water for many years, to the great benefit of the Company, and he hoped to the health and happiness of the inhabitants of the district. Then the Directors had been obliged to resist a claim in the Law Courts. Here, again, he could congratulate the shareholders. They came out of the Courts absolutely victorious. A British Jury took the Board's view of the case, and supported the line they were bound to take under the circumstances. He had said the contest with the Poole Corporation was a friendly one. Perhaps this was more remarkably shown by the fact that, while the Directors had been having this little "talk" with them over the water supply, they had entered into an agreement with them with regard to public lighting in the whole of the extended borough of Poole. This agreement was for three, five, or seven years; and the Company would strive to maintain it as long as they possibly could, by endeavouring to do their duty in the lighting up of Poole in the best possible style. They had also to congratulate themselves as usual upon their increased business. In the report there appeared the ordinary statement to the effect that there had been a substantial increase in both the gas and water rental. Perhaps it would be of interest to the shareholders if he gave some figures with regard to the recent improvements so far as the sale of cookers and fires and water-heaters was concerned. The Engineer and General Manager (Mr. Harold W. Woodall) had supplied him with the figures, which, he thought, were somewhat remarkable. In the corresponding half of 1905, they sold 12 cookers; in the past half year, 52. Last year, in the first six months, 57 fires were sold; this year, 105. Last year they did not sell any water-heaters at all; this year they had sold 39. These figures only referred to the cooking and heating appliances sold; but those let on hire had also increased by no less than 9 per cent. This would give the shareholders some idea of the energy and enthusiasm that were being displayed at Bournemouth, and the rate at which developments were taking place. He should not like to close his remarks without drawing the attention of the shareholders to the very satisfactory statements that had recently been made in reference to the way in which the Company carried out their work. It would be remembered that they were called upon to soften the water; this being mainly in the interests of the large laundries in the town, who were anxious, indeed, to have softened water to enable them to carry on their business. It was therefore very gratifying to know that, on a recent public occasion, the proprietor of one of the largest laundries in the town openly stated that, in his opinion, the Company had fulfilled, and more than fulfilled, the obligations they were under to soften

the water according to the request made by the Corporation. Then again, in a paper read at the recent congress of the Royal Sanitary Institute, Dr. Nunn, the Medical Officer of Health for Bournemouth (who ought to be, and who was, their most stringent critic with regard to the supply of water), passed the highest possible encomiums upon the manner in which the borough of Bournemouth had been supplied with water by the Company. He (the Chairman) was quite sure the following sentences from the paper would be read with the greatest satisfaction by the shareholders: "It is hoped that both in quantity and quality, the requirements of Bournemouth in the future are amply provided for. . . . There is no reason why, both chemically and bacteriologically, the public water supply of Bournemouth may not continue to be perfect; and in that respect we may be satisfied that the town is well cared for. If experience goes for anything, this Company have at their service engineers and experts of the highest quality. . . . During the whole of my experience as Medical Officer of Health for Bournemouth, I have never known a single case of illness which could be said to have been caused by the public water supply. I am pleased to bear my testimony to this fact. We have never been short of water, and never stinted in the quantity of our supply; and I believe that, for many years to come, the quantity of water will be sufficient, even if the population gets over 100,000." This he (the Chairman) thought, coming from Dr. Nunn, in his position as Medical Officer of Health, was a very valuable record of his opinion as to the way in which the Company had done their work. If he (the Chairman) wanted any other source of congratulation, he should refer to the Company's last issue of debenture stock, which was applied for four times over; and although the Board fixed the price at a figure that was by some considered rather high—£103—the average price realized was £104 17s. This was very gratifying. In conclusion, he might say the Directors recognized the responsibility that was upon them; and they would try to continue to maintain the very high position the Company had reached.

Mr. CORBET WOODALL seconded the motion, which was unanimously carried.

Proposed by the CHAIRMAN, and seconded by Mr. R. HESKETH JONES, dividends were declared at the following rates per annum: 6 per cent. on the preference stock, 7 per cent. on the "B" shares, and 14 per cent. on the original shares.

Mr. A. W. OKE proposed a vote of thanks to the Chairman, Directors, and officers and staff for their services during the past six months. He remarked that the shareholders had heard with interest that the Directors had been most successful in both Houses of Parliament in looking after the Company's interests, and in the Law Courts in what was an uncertain question of litigation, which was inevitable in this case. They had also heard most satisfactory testimony of the value of their water supply from an expert who had control of the health of the borough. If they were to inquire what were the real reasons of the success of Bournemouth as a watering-place, he thought they would have to include the fact that the Company had for many years past furnished an excellent, pure, and abundant supply of water, and that the town had always been lighted at a reasonable price. In addition to this, the Company rejoiced in a reputation in the financial world which might be the envy of many other gas companies.

Mr. J. C. BENWELL, F.C.A., seconded the motion, which was cordially agreed to.

The CHAIRMAN, having acknowledged the vote, said it would be perfectly impossible for them to maintain the position of the Company unless they had full confidence in their officials and their staffs, from the highest to the lowest. This they had; and he should therefore like to unite himself and his colleagues with the portion of the resolution referring to the officials and their staffs.

Mr. WOODALL and Mr. CASH also briefly responded; and the proceedings terminated.

BARNET DISTRICT GAS AND WATER COMPANY.

The Half-Yearly General Meeting of this Company was held last Friday, at the Albion Tavern, Aldersgate Street, E.C.—Mr. A. H. BAYNES in the chair.

The SECRETARY (Mr. E. W. Drew, F.C.A.) read the notice convening the meeting; and the Directors' report and the accounts were taken as read.

The CHAIRMAN, in moving the adoption of the report and accounts, said it was not his intention to detain the proprietors by any lengthened remarks. Adverting first of all to the gas department, he thought it was satisfactory that the make of gas for the past half year, as compared with the corresponding six months of 1905, exhibited an increase of 3,994,000 cubic feet—in round figures, 4 million cubic feet, involving the carbonizing of 364 tons more coal. The gas made per ton of coal had been 10,860 cubic feet. The gas sold during the half year had been 2,655,000 cubic feet in excess of the June half of 1905. The cash receipts had amounted to £10,735—an increase of £982. With regard to residuals, low prices had continued; the average price of coke per chaldron having been 8s. 9d., instead of 9s. 3d. as in 1905, and sulphate £7 10s. 3d., compared with £7 19s. 1d. The cash receipts from the residuals in the six months presented a decrease of £130, as compared with 1905. The total net profit on gas and residuals during the half year showed a decrease, compared with the first half of 1905, of £973. The explanation of this diminution was this: There had been a decrease of £130 in the profit on the residuals. Then there had been a reduction of 2d. in the price of gas, involving £250. There had been the cost of the conversion of 300 public lamps to the incandescent system (£244); but by this the Company had secured a five-year contract. Then there had been the increased cost of repairs on mains and services, amounting to £262. Other small items made up the balance of £87. There had been an increase in the slot-meters connected; and the total number at present was 1002. Turning to the water department, the receipts from water-rates during the half year had been £15,657—an increase of £442 on the corresponding six months of 1905. This increase would have been considerably more, had the supply of water temporarily taken by the authorities of Colney Hatch Asylum during the time they had been engaged in deepening their own well been continued. A considerable amount from this source was included in the half-year's accounts ended June, 1905; but it had entirely ceased during the half year ended December last. The total net profit on gas, residuals, and water, including fittings, for the past half year—after allowing for interest on loans and income-tax—had been £10,002. A sum of £9049 would be needed for the dividend now recommended; leaving £953 to be added to the balance to be carried forward. During the half year, the gas-mains had been increased by 810 yards; and the water-mains by 1831 yards—a total increase for the past six months of 2641 yards. It might perhaps be well to mention that, in the present balance-sheet for the first time, there had been included, on both sides, the receipts from stoves and fittings account, and the expenditure on repairs to stoves and fittings. It would be remembered that, at the last half-yearly meeting, he stated that, with a view to amply providing for the growing demands for water of their rapidly increasing parliamentary district, the Board resolved to sink a new well at Northaw; and he had to report to the proprietors that day that this important undertaking was proceeding.

Mr. I. A. CROOKENDEN seconded the motion, which, after a few inquiries from Mr. W. Billing regarding matters purely of account, was unanimously adopted.

On the motion of the CHAIRMAN, seconded by Mr. ALFRED LASS, a dividend was declared for the half year, less income-tax, at the rates per annum of 7½ per cent. on the "A" and "C" stocks, 6½ per cent. on the "B" stock, and 5¼ per cent. on the "D" capital, gas and water stocks.

The CHAIRMAN next moved a resolution expressing satisfaction with, and the best thanks for, the services of the Engineer and Manager (Mr. T. H. Martin), the Secretary (Mr. Ernest Drew), the Cashier (Mr. Wright), and the members of the officers' respective staffs.

Mr. G. GWINN seconded the motion, which was very cordially passed.

All three gentlemen named in the resolution duly expressed their acknowledgments.

CREATION OF DEBENTURE STOCK.

The meeting was then resolved into an extraordinary general one, for the purpose of considering, and, if deemed expedient, passing a resolution rescinding the resolution for the creation of debenture stock under the Barnet District Gas and Water Acts, 1872, 1883, and 1887, passed at the extraordinary general meeting held on Feb. 23, 1906, and sanctioning the creation and issue, under the Barnet District Gas and Water Acts, 1872, 1883, 1887, and 1904, of £124,850 consolidated debenture stock, bearing interest at the rate of 4 per cent. per annum, and the disposal of such stock in such manner, at such times, and on such terms, as the resolution may provide, and the re-borrowing of mortgage moneys which shall have been paid off.

The CHAIRMAN asked the Solicitor (Mr. C. A. Bannister) to read the resolution, and to explain its purport.

Mr. BANNISTER read the resolution, the gist of which is given above. Proceeding, he said that it would be within the recollection of the proprietors that, at the February meeting, they passed a resolution for the creation of debenture stock, but limiting the borrowing powers under the Acts of 1872, 1883, and 1887. The difference between the resolution then passed and the one now before the shareholders was this, that it was now proposed there should be created one debenture stock under all the Company's Acts of Parliament, so that there might be one debenture stock ranking equally. Otherwise it might be, had they acted on the resolution passed at the February meeting, and then passed another resolution for the issue of debenture stock, the one might have ranked before the other. Now the whole of the debenture stock, representing the whole of the Company's borrowing powers, would rank equally, and bear 4 per cent. interest. He hoped he had made it plain—first, why the resolution passed at the February meeting had to be rescinded, and next that the debenture stock they were now going to create was to be one debenture stock representing the whole of the borrowing powers on the Company's capital.

The CHAIRMAN formally moved the adoption of the resolution read by the Solicitor; and, Mr. CROOKENDEN having seconded, it was unanimously carried.

Mr. GWINN proposed a hearty vote of thanks to the Chairman and Directors for their attention to the Company's business.

Mr. SAMUEL CUTLER, in seconding the proposition, said the proprietors must congratulate themselves on the Company's improving business. It was extending half year by half year; and they all recognized how much they were indebted to the Directors for their services.

The motion was heartily passed; and the CHAIRMAN's response concluded the proceedings.

Workmen Entombed in a Well.—Public feeling in Brussels, and indeed throughout Belgium, has lately been in a state of tension over the fate of three men who were entombed in a well in course of construction in a field adjoining the Bois de la Cambre, close to Brussels. A subsidence of earth occurred on the 10th inst., completely blocking the lower gallery shaft. Engineers were engaged night and day in the work of piercing the lateral galleries, so as to reach the entombed men; but lack of air in the shaft seemed to render their rescue more than problematical. On the following Monday, it was thought faint knocks were heard in the portion of the shaft where the men were confined; and next evening shouts were sufficiently audible to justify the certainty that one man at least was alive. After 11 days' continuous endeavour to find the entombed men, the engineers abandoned the search as fruitless. Successive sections of the shaft disclosed nothing but masses of timber and fallen earth, and last Tuesday the lowest level was reached. It is supposed that the sounds of life were, therefore, illusory, and the bodies of the victims are believed to be lying in the mud at the bottom of the shaft; but, as this is covered with many hundred tons of *débris*, it is doubtful whether they will ever be recovered.

PROVINCIAL GAS AND WATER COMPANIES.

Gas.

Consumers Gain and Shareholders Lose at Barnsley.

There was only a small attendance of shareholders at the annual meeting of the Barnsley Gas Company, held on the 20th inst., under the presidency of Mr. E. G. Lancaster. The Secretary (Mr. W. W. Hutchinson), in the course of a comparative statement, pointed out that there was a decrease of £707 in the cost of manufacture; but that distribution cost £249 more, and the repair, refixing, and renewal of meters £328 more. The total expenditure was £380 less; and the net profit showed a decrease of £393. There was a reduction of £558 in the amount received from coke, and £150 from tar; but ammoniacal liquor produced £162 more. The income from residual products was £546 less, and the total income £773 less, than before. In moving the adoption of the report and accounts, the Chairman said it was the first time for several years that the balance-sheet was not satisfactory. They had failed to make the full dividend by £881; and but for the discount allowed to customers (£1104), they would have made the full dividend with £222 to the good. This was money really belonging to the shareholders; but the Directors could not go back on their arrangement, though they had been a little too sanguine by increasing the amount of discount granted. The balance-sheet showed that they had worked the concern for £380 less money, and had sold more than a million cubic feet more gas. The reduction was due to the fall in the value of coke and tar, which accounted for £780 out of the £881. Last year, it would be remembered, they made up the full dividend by taking £448 from their floating balance; and the best way, the Directors thought, of dealing with the present situation was not to again reduce this floating balance, but to lower the dividend on the ordinary stock. The other classes of shareholders would not suffer at all. Speaking of the effect of competition instituted by the introduction of electricity, the Chairman said they estimated it would mean a loss of 12 million cubic feet of gas sold; but, as a matter of fact it had reached 15 millions. The report was adopted.

Increased Consumption at Cork.

At the half-yearly general meeting of the Cork Gas Consumers' Company last Friday, the Directors reported an increase in the gas-rental in the six months ending the 30th of June, caused principally by the extended use of gas for cooking and heating and the large number of prepayment meter consumers. The revenue was £26,383, and the expenditure £18,646; leaving £7737 to go to the profit and loss account. The balance on this account was £6350; and the Directors recommended a dividend at the rate of 8 per cent. per annum. This would absorb £5555, and leave £795 to be added to the reserve fund. The Chairman (Mr. G. Lynch), in moving the adoption of the report, said there had been a small increase in the quantity of gas sold in the half year. It would have been larger but for the continued and increasing use of the incandescent burners, which give a larger amount of light for a smaller consumption of gas. The number of consumers continued to augment steadily. There had been put up 99 additional large cooking and heating stoves, 267 smaller ones, and 221 slot meters; and more gas had been sold than during the corresponding period immediately before the Electric Light Company commenced lighting. Some striking instances had recently occurred showing the preference now being given to gas over electric light as an illuminant. The use of gas for cooking was becoming daily more popular, as, besides its convenience and cleanliness, it was found also more economical than coal, when reasonable care was taken to avoid waste when it was not being used. Improved stoves for heating were now manufactured to suit practically all situations; and they had been adopted in Cork for several of the large shops and warehouses, as well as the Opera House. Mr. Frank Mahony seconded the motion, and it was carried without discussion. The dividend recommended having been declared, and the retiring Directors and Auditor re-elected, a suggestion was thrown out that the Directors should consider the advisability of providing fittings and supplying incandescent burners. The Chairman said the Directors would consider the matter; but the reason they had refrained from providing fittings themselves was that they did not like to interfere with the traders of the town.

Present and Prospective Prosperity at Eastbourne.

The veteran Chairman of the Eastbourne Gas Company (Dr. G. A. Jeffery, J.P.) had the pleasure, in moving the adoption of the report and accounts, at the meeting of shareholders on Monday last week, of congratulating them on the successful result of the working of the undertaking in the six months ending the 30th of June. The revenue account showed a profit of £8354; and the profit and loss account a balance of £23,990, after payment of the half-yearly dividends in February, and meeting other charges. The Directors were therefore able to recommend dividends at the rates of 15 per cent. per annum on the "A" and "C" shares, and of 12 per cent. per annum on the "B" shares. The payment of these dividends, said Dr. Jeffery, would leave a "respectable little balance" of over £16,000, which it was proposed to carry to the next account. Referring to the increase in the price of coals, he stated that the Company were fortunate in having a contract which did not expire till June next year. With regard to residuals, tar had been selling at a low rate. But it had been used by the Corporation in making a beautiful carriage-way in the Terminus Road; and it was being employed for a like purpose elsewhere. This would surely cause the price to go up, and consequently benefit the Company. He had received a note on the subject from the Resident Engineer (Mr. John Hammond), who pointed out that, after four years' experience, the Engineer of the Department of the Seine had reported that the dust resulting from wear of the streets had almost entirely disappeared as the result of tarring the surface. This, together with the reduction in the expense of maintenance, would more than pay the first cost and subsequent outlay on the installation of the apparatus. "Once it is established," said Mr. Hammond, "that water-proof dustless roads would reduce the highway rate, their introduction will only be a matter of time." Dr. Jeffery said they must hope for this; and he did not see why tarred roads should not become general. So far as the Company's works were concerned, they and the storage plant were on so ample a scale that nothing need be spent for some years to come. As to the popularity of gas as an illuminant, the shareholders could read for themselves in every paper that gas was considered to be—especially for street lighting—the cheapest and best illuminant. When municipal or any other authorities wished to lessen the demands on the ratepayers' pockets, they must use not only incandescent mantles but intensified gas. He thought this was acknowledged both in England and on the Continent. Mr. T. Bennett seconded the motion; and it was carried. The dividends recommended having been declared, and the retiring Directors and Auditor re-elected, the remuneration of the former for the ensuing year was fixed at £1000, free of income-tax, and the salary of the Secretary (Mr. J. S. Garrard) was increased by £50 per annum. Mr. Garrard having returned thanks, the services of the Directors, officers, and workmen were acknowledged—the indebtedness of the shareholders to Mr. Hammond being specially mentioned. Dr. Jeffery and Mr. Hammond having replied, Dr. Mitchell moved a vote of thanks to the Chairman. The motion was seconded by Mr. Bennett and supported by Mr. H. E. Jones, the Company's Consulting Engineer. The latter, referring to the great prosperity of the undertaking, pointed out that it was due to the low price at which the Company sold their gas, and that this might be attributed to the continuity of policy represented by the continuance in power of the Chairman. This cheap gas had secured for Eastbourne one merit which it possessed above all towns he knew, whether they were seaside resorts or not. By enabling people to use gas for cooking purposes, it kept the town free from smoke. A few days previously, when driving with Mr. Hammond from Willingdon, to which place the Company were extending their mains, the only smoke he saw came from the chimney of the electric light station. It was a great advantage to have a smokeless town when cooking was going on in the middle of the day. He repeated that cheap gas was due very much to a continuity of a liberal, deliberate, and yet careful policy in their expenditure. He concluded by wishing the Chairman long life. The motion having been carried, the Chairman said it was difficult for him to adequately express his thanks for the kindness accorded to him. Referring to the extension to Willingdon, he remarked that it had been undertaken at the request of both occupiers and owners; and though it might not be immediately remunerative, it would be eventually. The proceedings then terminated.

Good Results from an Exhibition at Kettering.

In moving the adoption of the report at the recent half-yearly meeting of the Kettering Gas Company, the Chairman (Mr. J. T. Stockburn, J.P.) said there had been a slight falling off—about 3 per cent.—in their output of gas. This would not be surprising, considering the competition they had had to face, such as the electric light and suction gas. They had also suffered by the introduction of the incandescent burner, which gave a better light and consumed less gas. In order to meet all this competition, they had attempted to increase their business in other directions; and they had been fairly satisfactory. The consumers were 78 more than at the end of December last, and they also had 160 more cooking-stoves in the town. It would appear to be rather a remarkable thing that there were so many cooking-stoves in use—the total number being 3623. It might be more or less interesting to the public to know that at the recent exhibition, which took place at the Victoria Hall, the Company had a stall, and made a show of what they could do in these matters, more particularly in regard to the introduction of stoves. After the show, they found that there was a demand for more than 200 stoves as shown at the exhibition. This came so rapidly that they were not able to meet it at the time, but had since made every effort to do so. During the quarter they had already added 160 cooking-stoves, which materially affected the income. There was one other matter which affected them. During the present half year they had reduced the charge for gas for power to a rather considerable extent; and they had arranged that payment should be made monthly, instead of quarterly. These matters were thoroughly satisfactory to them, and the concern was in a very good position. The report was adopted, and the usual dividends of 11¼, 8¼, and 5⅝ per cent. upon the different classes of stock were declared, free of income-tax.

Good Progress at Portsmouth.

At the half-yearly meeting of the Portsea Island Gas Company on Saturday, the accounts presented showed a revenue for the six months ending the 30th of June of £99,919, compared with £96,811 in the corresponding period of last year; and the expenditure was £81,006, against £78,372. An amount of £18,913 was carried to the profit and loss account, bringing it up to £43,924, exclusive of £13,588 in the extraordinary renewals account, £53,042 in the reserve fund account, and £16,441 in the insurance fund account. The Directors recommended dividends for the half year at the rates of 13, 12, 10, and 5 per cent. on the several classes of stock, less income-tax. The consumption of coal at the works amounted to 50,337 tons; and 438,425 gallons of oil were used. The make of gas was 627,720,000 cubic feet—an increase from 622,951,000 feet in the corresponding period of last year. The gas sold was 593,569,500 cubic feet, compared with 583,213,800 cubic feet. In moving the adoption of the report, the Chairman (Alderman Sir John Baker, M.P., J.P.) observed that the half year covered by it had been important, inasmuch as the undertaking had shown progress in every way. The consumers alone had increased by upwards of 2000—from 33,638 to 35,739. They had, he was glad to say, been able to settle their assessment without going before the Recorder—an end which had been attained by exercising forbearance; and in the reconstruction of their works, which had been in progress for the last three or four years, he could state that for efficiency they might now challenge any gas company in the kingdom. He spoke highly of the exceptional work performed by the Engineer and General Manager (Mr. J. D. Ashworth), and said that the results obtained had been beyond expectations. As to the cost of coal, which it was anticipated would be materially increased, they had found that the price was actually a fraction less than at the old works at Flathouse; and, taken altogether, the progress of which he had spoken had been well maintained. The Deputy-Chairman (Mr. R. E. Hellyer) seconded the motion, which was supported by Mr. Howard C. Ward, who spoke

as to the economy exercised by all the officials. In reply to a question as to the action-at-law with regard to the discharge of water, the Chairman said that there was no pollution in the stream or ditch into which the water flowed. They had tried not to go to the Court; but they had been bound to do so, and it had already entailed an outlay of £900 without the costs. The report was adopted. It was decided to pay the dividends recommended, which would leave a balance of £25,992 to be carried forward. A cordial vote of thanks was passed to the Directors and staff; and suitable response was made by the Chairman. Subsequently the shareholders were conveyed in brakes to the new Hilsea works, of which a close inspection was made under the guidance of Mr. Ashworth. A full illustrated description of the works was given in the "JOURNAL" in October last.

Cooking and Laundry Competitions at Wakefield.

It was but a short report that the Directors of the Wakefield Gas Company had to present to the shareholders at the half-yearly meeting on Monday last week; but it contained the gratifying announcement that a sum of £9940 was available for distribution, and that this enabled them to recommend the payment of dividends of 5¾, 4½, and 4¼ per cent. on the various classes of shares. The Chairman (Dr. Statter), in moving the adoption of the report and accounts, referred to the satisfactory nature of the balance-sheet, and pointed out that the dividend had been earned, and a balance of £312 carried forward. He said the revenue account showed a larger expenditure on the manufacture of gas, chiefly under the head of "coals;" there being an increase in the sale of gas to the extent of 3,325,600 cubic feet, or 2·62 per cent., during the half year. The expenditure on the other items was normal. The total receipts (£22,430) showed a gratifying increase amounting to £953. Last year, the Directors were able to make exceptionally good terms for tar—terms which they were sorry to say could not be expected to continue. During the past six months, a number of lamps had been fixed on hire for the inside and outside lighting of shops, which had given great satisfaction to the consumers. The alarming fire which occurred in May to one of the gasholders might have been attended with serious consequences but for the prompt action of the Engineer (Mr. H. Townsend, M.Inst.C.E.), who fortunately was on the spot, and the hearty co-operation of the workmen. The Chairman next alluded to the new feature in the gas exhibition recently held—viz., the cooking and laundry competitions—to which reference has been made in the "JOURNAL," and which attracted large numbers of people each evening the exhibition was open. By the kind sanction of the Chairman of the Education Committee of the Wakefield Corporation (Alderman H. Smith, J.P.) and the members, the Company were able to offer a silver shield, mounted on an oak panel, for competition. Three girls were selected from each of the fifteen elementary schools in the district; the winning team to hold the shield for twelve months. The first fortunate possessor was the St. James's School, Thornes; and he (the Chairman) hoped that much benefit to the children would result. Mr. G. A. Moorhouse seconded the motion; and it was carried. It was next unanimously resolved that, after paying the prescribed dividend of 4½ per cent. on the preference stock, the dividends recommended in the report should be paid (less income-tax), and the balance be carried to next account. The retiring Directors (Messrs. G. A. Moorhouse and A. M. Lawrence) and Auditor (Mr. C. Hopkinson) having been unanimously re-elected, a hearty vote of thanks was passed to the Chairman and Directors for the satisfactory manner in which they had conducted the Company's business. In acknowledging the vote, the Chairman moved that the best thanks of the meeting be given to the officers and workmen generally for their services to the Company during the half year, coupling with the vote the names of the Engineer and the Secretary (Mr. W. H. Parker), both of whom responded in suitable terms; the former paying a tribute to the courageous services rendered by the foremen and workmen in saving the holder during the fire to which the Chairman had referred.

Additional Consumers and Larger Sales at Weymouth.

In the opening sentence of the report presented to the shareholders of the Weymouth Gas Company on Thursday, the Directors stated that the half year ended the 30th of June had been one of "solid progress, there having been a large addition to the number of consumers, a satisfactory demand for stoves, and a substantial increase in the sale of gas." The accounts accompanying the report showed that the quantity of gas sold was 47,555,300 cubic feet, which was 2,989,500 cubic feet (6·7 per cent.) in excess of that sent out in the corresponding half of the past year. On the 1st of April last, the price of gas was reduced from 3s. 4d. to 3s. 2d. per 1000 cubic feet; but the loss in revenue thereby incurred had been more than recouped by the larger output. The working had produced a profit of £2831; and as this was more than the amount required to pay the fixed interest on the debenture stock and the maximum dividend on the ordinary stock, the Directors recommended the declaration of a dividend for the half year on the latter stock at the rate of 5 per cent. per annum, less income-tax. The Chairman (Mr. J. E. Robens, J.P.), in moving the adoption of the report, said that when they assembled this time last year it was the first meeting after the installation of the electric light, and it meant a loss on the half year of 1,663,000 cubic feet. But this was confined simply to the first three months of the year. Afterwards they had not suffered a loss in any way, but on the succeeding half year had improved, and made 2,336,500 cubic feet additional to their former returns. He was glad to say that during the past year they had added 2,989,500 cubic feet; so that they had gained 5,326,000 cubic feet in their output. He thought that when the shareholders took into consideration the state of the electric light, they would see that the position the Company occupied was one on which they had every reason to congratulate themselves. He was glad the Directors were able to announce at the last meeting that they proposed another reduction of 2d. per 1000 cubic feet of gas; and he was happy to know that in doing this they were not asking the proprietors to make any sacrifice, because the consumers really contributed this sum by the manner in which they had helped to increase the output of the Company. They had become a part of the Company, because as soon as the specified 5 per cent. interest was paid, all the balance of profit had to pass to them. Within four years the reductions the Company had made had amounted to 15 per cent. off the price they charged four years ago. This was more than the half-year's dividend paid to the shareholders; and the consumers were paying this year £4232 less for their gas than they did four years ago. He thought this was very gratifying, and he was sure they all felt that the stability of the Company was assured. This was the fortieth year of their existence, and their position was certainly one with which they had every cause for satisfaction. They had reduced the price of their gas from 5s. 6d. per 1000 cubic feet, which was the figure charged when the present proprietors bought the concern, to 3s. 2d. Then the output was 20 million cubic feet; while now it was 102 millions. Then their capital was 37s. 6d. per 1000 cubic feet; now it was 12s. This showed that they had put themselves in a very fair position. Besides this, when they began they had not a shilling in reserve; whereas now their reserve fund was equal to all their wants, and they could look forward with equanimity to the future. Mr. Rowe seconded the motion; and it was carried. A vote of thanks having been passed to the Chairman and Directors, and acknowledged by Mr. S. J. Fowler, the Chairman said he felt that they could not separate without expressing their deep obligation to their Engineer and Manager (Mr. D. F. Colson) and his very efficient staff. He could speak of the Manager's devotion to the business as being of a very high order; and he thought that if the proprietors looked at the results since he had been with them, and remembered that he came just at a period when they had to fight the great fight to which they had been looking forward, and which had been successfully carried on, they would see how largely indebted they were to him and his assistants. The vote having been heartily accorded, Mr. Colson said that it gave him great pleasure to return thanks for the kind things said about him and the staff. He was quite sure that all his staff threw their whole heart and soul into the work; and from the result the proprietors would see they had all done their duty fully. He would convey to the staff and employees their kind vote of thanks.

Water.

From Gross to Net Assessment at Maidstone.

The report presented at the recent half-yearly general meeting of the Maidstone Water Company showed that there was a sum of £7894 to the credit of the profit and loss account; and the Directors recommended the payment of a dividend, free of income-tax, at the rate of 7½ per cent. per annum on the 10 per cent. shares, and at the rate of 5¼ per cent. per annum on the 7 per cent. shares. These payments would absorb the sum of £1680; leaving £6214 to be carried forward. The Chairman (Mr. H. W. Tyrwhitt-Drake), in moving the adoption of the report, congratulated the shareholders on what had been done during the half year. He reminded them that since this time last year the Company had been obliged, by circumstances over which they had no control, to charge their rates on the net instead of the gross assessment, which, of course, meant a reduction in the revenue. In spite of this, however, they had been able to show an increased revenue of £24 compared with the first half of last year. Having commented on the various items in the accounts, the Chairman stated, with regard to the new works, that everything had been duplicated where possible, including the pumps; and he felt sure the Company would not have to spend any great amount of capital for some years. Mr. Bensted seconded the motion. He said he felt that the Company were financially in a very happy position, and also as regarded the plant. The town had now a constant supply of water whatever might happen; and the works had been carried out as nearly as possible for the estimated sum. In reply to a shareholder, the Chairman explained that they had had during the year, besides their fortnightly chemical analysis, two bacteriological analyses; and when there was any doubt as to the water, they had it re-analyzed. The last report from Dr. Woodhead was highly satisfactory. The Mayor (Mr. W. Day) said he was pleased the question had been asked, and they now understood that the analyses of the water were made as frequently as before. He would like to take the opportunity, from a public point of view, of expressing his delight at the inspection he was permitted to make, with the Chairman and his co-Directors, of the grounds, wells, and works of the Company, when the new engines were started some time ago. He would like to inform the public that their interests were well guarded, and that they need not fear contamination. The report was adopted.

Water Famine at Nantwich.—The long-continued drought has seriously affected the Nantwich water supply. Last Thursday, the Urban District Council issued a notice informing the public that in consequence of the scarcity of water the town's supply would be turned off daily from nine in the evening until seven o'clock each morning. The notice adds that consumers must limit their requirements to domestic purposes only.

Aspatria Water Supply Dispute.—The water dispute affecting practically the whole of North-West Cumberland was further intensified last week by the refusal of the Aspatria, Silloth, and District Joint Water Board to comply with the suggestion of the Local Government Board to accept as binding the latter's decision as to whether the Water Board are liable for the cost of the branch mains in the parishes in the Wigton Rural District scheduled in the Water Board's Act of 1901, or whether the cost should be borne by the parishes themselves, which are outside the contributory areas, and have paid nothing towards the original outlay on the water scheme, the total cost of which has been about £45,000. The Water Board and the Holme Cultram Urban District Council agreed to accept as binding the Local Government Board's decision on an exactly similar point regarding the coast village of Skinburness, which is also in the scheduled area, as a sort of "test case"—this scheme not involving a large outlay; and the Local Government Board renewed its offer made last year to similarly arbitrate in the question between the Wigton Rural District Council and the Water Board. The Rural Council readily gave the required guarantee to abide by the head authority's finding; but the Water Board, to whom an adverse decision would be a very serious matter, have decided not to accept the decision as binding, but are sending to London a full statement of the facts.

ZURICH GAS SUPPLY.

Report of the Zurich Gas-Works for 1905.

The annual reports of the Zurich gas undertaking. forwarded by Herr Weiss, the Engineer, always contain matter of interest to his English colleagues, who recognize the high and progressive character of the work which he conducts in connection with the gas supply of he industrial capital of Switzerland.

Notwithstanding the fact that it is only a few years since Zurich built its new gas-works at Schlieren—of which an exhaustive description from the pen of Herr Weiss appeared in the "JOURNAL" in 1901—the growth of business has been so rapid that since 1903 the annual reports have regularly referred to considerable extensions of the plant which have been called for to meet the greater demand for gas. The present report contains the gratifying news that in January, 1905, a vote of 2,750,000 frs. was passed by the Corporation for extensions of the gas-works. Many of the projected extensions were completed during the past year. They comprised new or enlarged accommodation for the works' plant, the purchase of a new locomotive, new tar and liquor wells, new works' mains, and extensions of the works' railways. But some delay in carrying out the schemes was caused by a strike of bricklayers and labourers in the spring. Considerable extensions of the distributing system were made during the year.

There were carbonized in 1905, 70,165 metric tons of coal, and 512 tons of cannel. The make of gas per ton of coal declined from 10,988 cubic feet in 1904 to 10,826 cubic feet per English ton; but the output per retort showed an improvement. Coal was delivered on the works at practically the same cost as in 1904, and cannel was a trifle cheaper. There was an increase of 7·83 per cent. in the amount of gas sold, as compared with the preceding year. A falling off was experienced in the proportion of gas sold for street lighting and for lighting purposes by private consumers, though the absolute quantities increased. The gas consumed for heating and cooking amounted to 54·40 per cent. of the total output, against 52·93 per cent. in 1904. Suburbs of Zurich took 1·75 per cent. of the gas distributed. The unaccounted-for gas was 4·62 per cent. as compared with 4·15 per cent. in the preceding year. The number of burners in the public gas-lamps was 7315 on Nov. 30 last, of which only 73 were flat-flames.

There were slight decreases in the yields of coke and tar; but the ammonia increased to 0·1927 ton of true ammonia per 100 tons of coal carbonized. The laboratory of the gas-works was busy with tests for the control of the producer furnaces; and a new departure was made in the introduction of tests on the proportion of water in the tar. It was found that the water separated from the tar from Ruhr coal with much greater difficulty than from the tar from Saar coal. Attention was paid to the illuminating power of gas as a check on calorific power; and it was maintained at a somewhat higher figure (13 Hefners =about 11·8 English candles, per 5·3 cubic feet consumed per hour in the Elster argand burner), corresponding with the decreased make of gas per ton of coal. The net calorific power of the gas averaged 580½ B.Th.U. per cubic foot. In the experimental gas plant, 106 descriptions of coal were examined during the year—a large proportion being for the information of other gas-works, &c. Tests were made of the lime and oxide of iron used for purification, and of the spent oxide and gas liquor.

The report is, as usual, embellished with diagrams showing graphically the relations between the consumption of gas over different periods and for different purposes, &c.

INSPECTION OF GAS LIQUOR AND OTHER WORKS UNDER THE ALKALI ACTS.

District Inspectors' Reports.

In the last number of the "JOURNAL," we noticed the annual report of the Chief Inspector under the Alkali Acts (Mr. R. Forbes Carpenter). We to-day give extracts from the reports of some of the District Inspectors.

The first district is Ireland, which is under the supervision of Mr. E. G. Ballard. There are 32 sulphate of ammonia and six tar works; and with one exception, where there was a tendency to "slovenliness," they were all carefully conducted. During the year, large plant was erected for the manufacture of sulphate of ammonia from peat.* Products equivalent to 2598 tons of sulphate of ammonia were made in the district in 1905; the proportion of total liquor distilled by the continuous and intermittent systems respectively being 96 6 per cent. and 3·4 per cent. Many of the works registered as tar-works are establishments where tar is heated for the manufacture of roofing felt. These are mostly situated in Belfast; and they are, on the whole, well conducted. Those works where tar is distilled continue to conform to the requirements of the Acts, and no trouble arose throughout the year. Taking all the works registered throughout Ireland, Mr. Ballard says every desire is shown by the proprietors to comply with the statutory requirements.

Reporting upon the North of England district, Mr. J. W. Young, B.Sc., states that there are 58 sulphate of ammonia and six tar works under his supervision; and that 236 visits were paid to them and 97 tests made last year. Sulphate, however, was produced in 63 works out of the 132 in the district. Mr. Young says the output from the gas-works is very slightly less—50 tons—and seems to have reached its maximum; mild winters, enriched water gas, and the growth of electric power being the main causes for this. On the other hand, the output from the coke-ovens shows an increase of 58 per cent. over the preceding year. The coke-oven industry in Durham, with recovery of bye-products, is still increasing. Five new works were registered in 1905, others are doubling their plant, and more are being erected. As regards the method of destruction of the evolved sulphuretted hydrogen by treatment with gas liquor and subsequent combustion, this has proved successful in preventing the escape of this gas.

Mr. Ballard also supervises the district comprising Cheshire, North Wales, and part of Lancashire, in which there are 22 sulphate of ammonia and seven tar works. The number of visits was 449, and of tests made 556. With the exception of one sulphate works, Mr. Ballard had no cause to complain as to the way in which the manufacture was conducted at the various works. In this instance, the saturator was found to be in a leaky condition, and sulphuretted hydrogen was escaping. The plant was stopped, and the saturator repaired on making representations to the owners. The "heap" form of oxide purifier is extending in the district. At one works the manager stated that it had saved him £20 during the year in oxide alone, and that the ease with which it is handled for revivification is another great advantage possessed by this kind of purifier. Mr. Ballard says the same opinion is expressed wherever the "heap" purifier has been adopted. There are now in the district six of such purifiers in operation. Wherever there are pairs of the old type of box purifier, they are provided with lute valves for changing the direction of the gases from one purifier to the other. Practically the whole of the liquor produced in the district is treated by the continuous process.

In the Widnes and Runcorn district, which is under the control of Dr. J. Affleck, there are seven works producing sulphate and muriate of ammonia. Six of them were practically in full operation all the year; while in one the output diminished to about one-half of what it was two years ago, and from want of raw material the plant was entirely stopped during the last two months of the year. In two of the works, which are now producing about 60 per cent. of the whole ammonia recovered in the district, sulphate is made from Mond producer gases by absorbing the ammonia vapours in towers suitably packed and fed with a solution of the salt containing excess of sulphuric acid; no sulphuretted hydrogen being generated. In one works, sulphate is made from crude bone liquor by an intermittent system of distillation, and only traces of sulphuretted hydrogen are given off in the process. In another, gas liquor is first concentrated in a continuous still, and the product then converted into muriate of ammonia in the usual form of "striking" tank. The foul gases evolved in the latter operation—containing some sulphuretted hydrogen—are passed through a special furnace before going to the chimney. In another works, the ammoniacal liquor from coke-oven gases is distilled on the continuous system, either in the usual way for the production of sulphate (the foul gases containing sulphuretted hydrogen being sent to pyrites kilns), or with excess of lime, to prevent sulphide passing over, for use in a subsequent manufacture. In two gas-works in the district, sulphate of ammonia is made from gas liquor distilled on the continuous system; the foul gases being passed through the usual oxide purifiers. Dr. Affleck reports that these works are all carefully conducted, and the apparatus employed is in a satisfactory condition.

North and East Lancashire and part of Yorkshire form a district which is under the supervision of Mr. Herbert Porter; and in it there are 45 sulphate and muriate of ammonia works. There were unfortunately four fatal accidents in the district last year, the result of two explosions and a case of "gassing." There are 11 works in which ammoniacal liquor is produced, and 45 producing sulphate or muriate of ammonia. The total quantity of liquor distilled was equivalent to 22,673 tons of sulphate, and 98·02 per cent. was treated by the continuous process. The method in general use for dealing with the sulphuretted hydrogen from this process is by absorption by oxide of iron to the extent 39·92 per cent. of the sulphate produced. This is considerably lower than last year, as the Claus process continues to find favour as producing a commercial product, but more so as it is a cheaper method of dealing with these gases than the oxide purifier; the frequent re-charging of which entails heavy expense for labour in works of any considerable size. At one coke-oven works, where the gas liquor is distilled, the Claus plant has been successfully worked.

With regard to the fatalities in his district, Mr. Porter says:

> Two men were killed at a small gas-works by the exploding of the ammonia still, which at one time had been a steam-boiler. The still was provided with a relief-pipe which passed down through the top, and was sealed in the liquor; and it was found that the ammonia-pipe was blocked up between the still and the saturator. Why the relief-pipe failed to act and prevent the explosion, there was no evidence at the inquest to show. The still was blown through a stone wall and 30 yards into a field.
>
> Another fatal accident took place at a large sulphate works, where the waste gases are burnt in the oxide burners to be converted into vitriol. On their way, they passed through a worm condenser in a tank, and at the outlet end of this condenser was a 2-feet U water-seal, where the devil water passed away into a tank in the ground, from which it was pumped back to the still. In the top of this tank was a small hole, about ¾ inch in diameter, to admit the air, and for dipping purposes. A few feet away was a water-closet into which the man in question (a carter) went, and where he was found, a short time after, lying on his face half outside. Three men assisted to get him out; two of them were also slightly affected, but did not need any immediate attention, though they were sent to the hospital as a precaution. Oxygen was administered to the deceased man, but without effect. There were on these ranges of pipes two other seals, one near the still of only 7 inches, and another 2-feet relief-seal near the burners, the first of which should have given relief had there been any internal pressure. The plant and the closet had been in existence a good many years, but no cases of gassing had taken place previously. The firm at once removed the closet, and have arranged the condensing plant on the top of some buildings so as to be quite removed from the workmen in the yard.

Mr. Porter reports that the condition of the plant and the general management in the class of works in question is most satisfactory. The fourth fatality occurred in an alkali works.

The reports of the other District Inspectors and that of the Chief Inspector to the Secretary for Scotland will be noticed next week.

Scarcity of Water in Essex.—A serious state of things has been reached at Corringham, owing to the village well, on which 160 persons depend for their water supply, having run dry. For some time the Rector has kept the village supplied from his well, which, however, is now giving out.

* Probably the plant referred to in the paper read by Mr. T. Rigby at the meeting of the Engineering and Scientific Association of Ireland a few months ago, and noticed in the "JOURNAL" for April 17 (p. 166).—ED. J.G.L.

TAR-PAINTING OF ROAD SURFACES.

Evidence of Mr. H. P. Maybury before the Royal Commission on Motor-Cars.

In the "JOURNAL" last week (p. 529), we gave some extracts from the evidence of Mr. G. F. L. Foulger, the Distributing Engineer of the Gaslight and Coke Company, before the Royal Commission on Motor-Cars, on the effect of heavy traffic upon gas-pipes. Another witness was Mr. H. P. Maybury, formerly Gas Manager and Secretary to the Great Malvern Urban District Council, and now Surveyor to the Kent County Council, who dealt with the treatment of road surfaces for the prevention of dust. The following are some of the points to which he directed the attention of the Commissioners.

In the first portion of Mr. Maybury's evidence, he described the effect of motor-car traffic on roads, and pointed to the damage done by traction-engines and trailers, and then passed on to the subject of the treatment of road surfaces for the prevention of dust, on which he said the Kent County Council spent a considerable sum last year in experiments. They laid out about £600 for westrumite, and afterwards used a chemical preparation; but they had to discard it because they were threatened with actions for damages to vehicles and the pollution of streams through the chemicals. They had tried tar painting, and he thought they had done it fairly successfully. The Council issued a circular-letter to all the governing authorities in the county, whereby they undertook to pay a contribution equal to ½d. per square yard, to any urban or rural authority who chose to tar-paint the main roads through their particular villages, so long as it was done in a satisfactory and workmanlike manner. A good many authorities had taken advantage of the offer—Sandgate, Hythe, Folkestone, Sevenoaks, Tunbridge Wells, and Ashford; and the Kent Council also had done pieces themselves under the direct control of his department. Asked if he recommended the treating of the whole main road in this way, or only the section where it passed through populous places, witness replied that by doing it through populous places he thought the case would be met. He added: If we can assume a time when we shall have all the main trunk roads metalled with good hard material, then, assuming that we were to tar-paint the roads through the villages, we should get rid of the big cost for watering which is now a charge on the sanitary authority more than upon the county authorities for road maintenance. It would do away entirely with the road watering, and I think it would effectually cure the dust nuisance; but it is essential that this tar-painting should be done upon only good hard surfaces. It is not a bit of good tar-painting a limestone or a flint surface.

The next question was as to cost; the witness being asked, supposing he applied the tar to all his new roads, what the addition would be to the £5000 or £6000 a year he had estimated. He replied: I have worked that out very carefully. The costs have been important to my Committee; and I may say that what we have done is that we have used distilled tar specially prepared, for which we have paid 3½d. a gallon, and it has cost us 1¼d. per square yard for two coats. We put this on in the last week in May [1905] through West Malling, which supports perhaps the greatest traction-engine traffic in the county (it is practically the home of the traction-engine, and is on the main road from London to Folkestone), and it has stood the whole season. The particular piece of road has not been watered, and the surface is not in bad condition. Similar experiments carried out by the urban authorities already mentioned have been fairly successful. It would last a complete season—until the wet and frost began again. If the roads are treated in this way in (say) the last week in March or the first week in April, and have two coats of tar properly put on—and it must be proper tar—then I think we have got rid of the dust through the towns or villages, and we have saved the watering charges. The cost would be about £60 per mile. The tar must be put on in good weather. There must be a good hard surface—granite, or something equally hard—and you must have good weather and proper materials. We have tried ordinary gas-works tar, and it has been an absolute failure, although it was put on in the same way as the distilled tar. This does not soften under a hot sun or in warm weather; but the ordinary gas-works tar does, and peels off like a sheet of paper.

Asked by a member of the Commission whether he thought the tarring process would have an appreciable effect upon the life of the road, Mr. Maybury said he did. He considered that if they could only get the work properly done, and could make the roads impervious—and this was what they were trying to do—they had done a good deal to prevent wear and tear. He certainly thought the £60 per mile initial expenditure would come back again. Witness went on to describe other experiments he had carried out; one being the grouting of granite in hot tar. He said the Council had done a mile of road with blue Norway granite four or five miles on the Ashford side of Maidstone. They laid the granite on the old surface, and then poured hot distilled tar into it. On the top of this they laid chippings of the same material, and rolled it down. It had been down a few months, and made a very nice surface. Of course, it was a cheap way of doing tarmac. The cost of it had been 1s. 9d. per super yard, including tar, labour, stone, and everything else. Tarmac such as had been put down there would cost in Kent from 3s. 5d. to 3s. 9d. per superficial yard. The rolling was a particular factor of the process—indeed, it was everything.

This was practically all Mr. Maybury had to say about roads; but before leaving the subject the Chairman asked him how, supposing he had a free hand, he would deal with the roads with a view to avoiding dust, and whether, in order to be fairly economical, he would recommend any of the several processes of which he had spoken to be added to the good road making to which he had referred in his previous evidence. Mr. Maybury replied: I would certainly recommend the tar-painting of the surface; and, if one could afford it, I would also go ahead with the grouting-in with hot tar. If I had a free hand, and had to consider the financial aspect of the subject, I would do it everywhere, because it would save the scavenging so much, and be so comfortable to ride over.

THE LABOUR CO-PARTNERSHIP MOVEMENT.

Statistics for the Past Year.

In connection with the annual festival and exhibition of the products of societies who have adopted the principle of labour co-partnership, which was opened at the Crystal Palace last Wednesday by Mr. J. C. Gray, the Secretary of the Co-operative Union and the President of the festival for the year, the Labour Co-partnership Association (of which Mr. H. Vivian, M.P., is the Secretary) have issued statistics showing the position and progress of co-operative production during the past year. In the particulars furnished, however, no mention is made of the gas companies and other limited liability concerns which have adopted the principle of co-partnership and profit-sharing; the Association having decided to confine the statistics to co-partnership in co-operative societies only. According to the statement of the Association, co-partnership within the co-operative movement did not show any sensational result in the past year. There were 117 societies, against 120 in 1904. The capital (shares, loans, and reserves) was £685,200, compared with £652,623. The sales amounted to £1,127,141, against £1,079,964. The profit (including interest on shares but not on loans) amounted to £44,949, compared with £40,591; the losses ran up to £7395, compared with £5269; and the dividend on wages was £6508, against £6171. The Scottish societies increased from six in 1904 to seven in 1905; the capital decreased from £1,143,148 to £1,134,190; the trade went up from £2,449,581 to £2,537,253; the profit fell from £165,875 to £143,341; there was no loss, the amount in 1904 being £7; and the profit to labour went down from £15,353 to £13,988. If the totals are put together, therefore, the result is that in Great Britain there were last year 124 societies, against 126 in 1904; a capital of £1,819,390, against £1,795,771; a trade of £3,664,394, against £3,529,545; a profit of £188,290, against £206,466; and a loss of £7395, against £5296; while there was paid as dividend to labour, or as labour's share of the results over and above the standard wages, £20,496, compared with £21,524. It is claimed by the Association that, while these figures show the effects of hard times, they also prove that the established productive societies continue to grow, on the whole, in importance and stability, and that the impulse to form new societies is by no means dead. The Association point to growth over a longer period as cause for satisfaction and encouragement. In 1883 the number of societies was 15, the capital £103,436, the trade £160,751, the profit £9031, and the loss £114. The dividend to labour was not known in that year; but in 1893 it was £8225. The leaders of the labour co-partnership movement believe in its future.

NEW PUBLIC SQUARE AT BURTON-UPON-TRENT.

Adoption of Incandescent Gas Lighting.

There has recently been formally opened by the Mayor of Burton-upon-Trent (Alderman T. E. Lowe) a new open space in front of the Town Hall. It is the outcome of a movement initiated in the winter of 1894-5 for the establishment of a permanent memorial of Lord Burton's great generosity to the town. His Lordship was interviewed on the subject, and eventually consented to the memorial taking the shape of a town improvement. Moreover, he made the generous offer of contributing £4000 towards the cost. The project was in abeyance for some time; but in the spring of 1902 a definite move was made in the direction of carrying it out. For three years negotiations were in progress for the acquisition of the property to be removed; and by the summer of last year they were completed, and the final arrangements made for clearing the site. A commencement was made just before Christmas, when a number of the unemployed were set to work, under the Distress Committee, to demolish the old property. Sufficient progress had been made by the 4th inst. to allow of the opening ceremony being performed. The new open space, which is called King Edward Place, gives a finish to the Town Hall, and adds to St. Paul's Church and Vicarage and the neighbouring buildings. St. Paul Street East has been widened from 41 feet into a carriage way 62 feet in width, with footpaths 11 feet wide on either side. Facing the Town Hall are slopes which will be planted with shrubs in the autumn, and a plot will be turfed. The whole will be enclosed by low wrought-iron railings. The improvement calls for notice in our columns from the fact that incandescent gas is to be employed in lighting the new street, though the Corporation own the electric light undertaking; and Mr. F. L. Ramsden, the Gas Manager and Engineer to the Corporation, has fitted two tramway standards with wrought-iron brackets of artistic design, supporting two "Whitehall" lanterns, each containing three burners.

LIGHTING OF THE NEW TOWN HALL AT CORK.

Corporation Prefer Gas.

The subject of the lighting of the new Town Hall at Cork was under the consideration of the Law and Finance Committee of the Corporation on Monday last week.

The City Engineer and the City Analyst reported that they had carefully examined proposals received from the Electric Light Company and the Gas Company with reference to the lighting of the Town Hall. As regards the Gas Company, the cost per hour for lighting the whole building, with an installation giving 8960-candle power illumination, would be about 11½d. per hour, and the cost of fittings and fixtures would amount to £86. As to the question of maintenance, no particulars were given; but on the basis of the working of the lighting of the Carnegie Free Library, the maintenance of mantles and lamps might be put down at about £1 per annum. The Electric Lighting Company's proposal was for an installation of 8840-candle power, which would cost 1s. 8½d. per hour; and the cost of wiring, lamps, and general fittings would be £139, which would include the maintenance of the

lamps and the installation. The relative cost of the two illuminants would be as 23 : 41. The City Analyst said the largest lamp the Electric Light Company undertook to give them was one of 1700-candle power; and the largest lamp the Gas Company would provide was one of 1000-candle power. When lamps of large power such as these were burned, the cost of gas and electricity approached very near each other. But when one commenced to use smaller lamps, it was then the price of electricity became great compared with gas; and in small lamps electricity was nearly four times the price of gas.

The Lord Mayor suggested that the Gas Company should be asked to put in the fittings free. Alderman Forde said in that case they should give the Company some guarantee that the contract would not be taken from them the following year. It was decided that the Secretary should be ordered to write to the Company, saying they were disposed to adopt gas as the illuminant, and would give say [?] years' guarantee, provided the Company put in the fittings free on the same principle as that adopted at the Free Library.

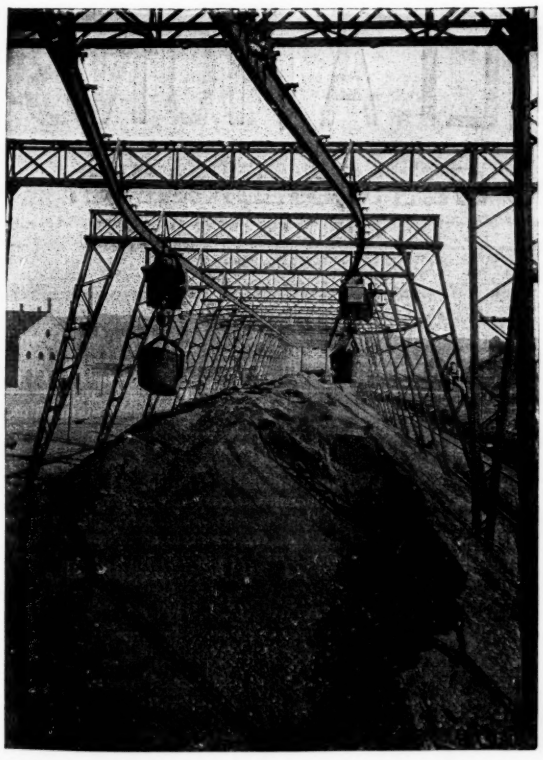
It may be mentioned that the lighting of the library referred to was transferred from the Electric Light Company to the Gas Company after a prolonged investigation; and it is giving entire satisfaction.

LIVERPOOL WATER FOR BIRKENHEAD.

The Provisional Agreement Adopted.

A Special Meeting of the Birkenhead Town Council was held last Wednesday for the purpose of discussing the terms provisionally agreed to between the Water Committees of the Birkenhead and Liverpool Corporations for the supply of Vyrnwy water to the borough. The MAYOR (Mr. W. G. Wall) presided.

Alderman BLOOR, the Chairman of the Gas and Water Committee, said he proposed to take an exceptional course with regard to the minutes. Instead of moving them as a whole, he thought it better to move one resolution, which was as follows: "That this Council do confirm the proceedings of the Gas and Water Committee, and do adopt the report of the Committee to the Council, dated the 3rd of August, as amended by the Committee on the 17th of August, 1906; and do approve and agree to the terms and conditions therein set forth, upon which a supply of water to Birkenhead can be obtained from the Corporation of Liverpool, subject to the settlement of details and to a satisfactory agreement being entered into with the Liverpool Corporation, and also provided that the Liverpool City Council approve the arrangement with all reasonable despatch." Alderman Bloor proceeded to review the circumstances which had led to the agreement with Liverpool, and then explained its terms in detail. He said the first clause provided that parliamentary sanction would have to be obtained before the agreement became operative; and the Liverpool Corporation undertook to secure this sanction at their own cost. The same clause fixed the basis of the water charges for Birkenhead, which were to be the same as those levied upon Bootle. The Liverpool Corporation did not contemplate any rise in the charges; on the contrary, they anticipated the possibllity of reductions in future. In clause 2, the probable extension of the boundaries of Birkenhead was contemplated; Liverpool contracting to supply the added areas upon the same terms as the existing borough. Birkenhead would be left with a free hand as to the extension of the boundaries. The same applied with reference to Oxton and Rock Ferry, if the time ever came when they ceased to be supplied with water by the Wirral and West Cheshire Company. In clause 3, provision was made for the supply of Vyrnwy water for some time from the Wallasey main. The object of this was that Birkenhead might get a supply quickly, without waiting for the completion of their independent conduit from Hatchmere, capable of supplying 5 million gallons daily. This conduit would be constructed entirely at the cost of Liverpool, and would have to be completed within five years of the passing of the Act. The estimated cost of the main would be £120,000 or £130,000. This was the concession which had been made by Liverpool in the later negotiations, but which had been previously withheld. Clause 4 provided that so long as the existing Birkenhead wells were used, the Vyrnwy supply should not be less than 1 million gallons per day. There was a complaint that the Birkenhead water was growing harder, and its mixture with the soft Liverpool water would be welcomed by all traders and manufacturers in the borough. In clause 5, there was a stipulation that Liverpool would contribute £50,000 towards the paying off of the Birkenhead water debt. Clause 6 provided for the assumption by Liverpool of the whole of the property of Birkenhead's water undertaking, except some small portion upon which property for other purposes than water supply had been built. It provided also for a renewal fund, which amounted at the moment to £50,000, being transferred to Liverpool. The actual cash payment by Liverpool to Birkenhead would be substantially £44,000 net. The Committee had tried very hard to secure better terms, but it was not possible. Liverpool was unyielding; and if Birkenhead had insisted upon better terms, the negotiations would have been broken off. In clause 7, provision was made for the collection of the water charges at Birkenhead by the Birkenhead staff as at present. Clause 8 provided for the streets being opened up by Liverpool for the purpose of laying new mains or repairing old ones, and the work of restoring the pavement to its original condition being done by Birkenhead at the cost of Liverpool. Clause 9 related to the representation of the Birkenhead Council on the Liverpool Water Committee. Four members were asked for, but Liverpool would only consent to two. There were eighteen or nineteen members on the Water Committee; and as Bootle had not more than two members, the Liverpool Committee argued that Birkenhead should be content with a similar representation. In the schedule which followed these clauses, the properties to be handed over to Liverpool were set out. Discussing the proposals in regard to their effect upon the water charges and the general financial position of the borough, Alderman



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Bloor mentioned that the present charges in Birkenhead were as follows: To domestic consumers, 10¼d. in the pound; for trade supply, 8·55d. per 1000 gallons; for sanitary purposes, 7·2d. per 1000 gallons; and for shipping, 3s. 4d. per 1000 gallons. Under the Vyrnwy scheme, the charges would be: Domestic supply, 1s. 3d. in the pound; trade supply, 9d. in the pound on the assessment of the premises, and 6d. per 1000 gallons; for sanitary purposes, the same; and shipping, 2s. 6d. per 1000 gallons. The present Birkenhead charges yielded an annual profit equal to 1¼d. in the pound; so that, taking the domestic consumers as being the most important upon which to judge of the character of the new charges, they were at present paying 9d. in the pound net, and under the Liverpool proposal the actual charge would be 1s. 3d. in the pound. The net result of accepting the Liverpool scheme would be that the domestic consumer would pay more and the traders less than at present. It was estimated that Birkenhead's water debt by 1908, when the agreement came into operation, would be £181,000. This would be reduced by the £50,000 already mentioned; leaving £131,000 to be paid off by Birkenhead, which was equal to a rate of 3d. in the pound. Liverpool's charges were based on a 6d. water-rate and a 6d. rental, the same as in Bootle; but Birkenhead would have to pay an additional 3d. in the pound until the water debt was extinguished. The scheme was a good one under the circumstances; and the Committee had decided in favour of its adoption. Personally, he would like to have got better terms; but they must bear in mind that when a bargain was made there were two parties to it. Each of the authorities concerned endeavoured to do their best in the interests of the community they served, and each naturally, of course, endeavoured to get the best terms from the other. As far as the Birkenhead Committee were concerned, they had carried the negotiations as far as they were practicable. He had no reason to expect better terms from Liverpool, even if the Council thought of hanging up a decision for a time. He was satisfied that they had obtained from Liverpool absolutely the lowest terms; and the scheme presented was the best that the Birkenhead Council could possibly hope to get. Some of the advantages of the scheme were the following: It did away with any uncertainty as to getting a Bill. Under the Alwen scheme, it was just possible they might not have carried their Bill. There was some uncertainty and anxiety about this which the present scheme removed. It admitted Birkenhead into partnership with Liverpool in the huge water undertaking of which she was in possession. This was no small privilege when they realized that Liverpool had already spent upwards of £6,000,000 in order to provide herself with water, and towards the amount so expended Birkenhead had contributed nothing; yet they were admitted to complete partnership. Then the scheme enabled them to know beforehand what the cost of their water would be, unless, of course, Liverpool varied the charges, as it might do as the years went on. If they had gone on with the gravitation scheme, it was possible that the estimated figures given in the report might have been exceeded. He was satisfied that Mr. Deacon amply provided for every contingency for which he could think in reference to every considerable item of expenditure; and, after the experience which he had had in this matter in regard to other water schemes, they were entitled, he thought, to rely with very great confidence upon his assurance that the scheme would be carried through for the sum mentioned in his estimate. At the same time, they knew that many unforeseen events happened in connection with gigantic undertakings of this kind, and there was a possibility of these estimates being exceeded. There was no uncertainty under the scheme before them. They knew to a fraction what the water would cost. Birkenhead would also avoid the creation of a new debt; and this was thought to be eminently desirable. Furthermore, in regard to the expenditure in front of them—where they would have no alternative—when Birkenhead went to borrow large sums of money in respect of these things, the lower they kept the debt of the borough the easier it would be to borrow, and the more favourable terms would be secured. The whole debt of the borough was now about £2,000,000, which worked out at £18 4s. per head of the population. If they had gone forward with the gravitation scheme, it would have been £2,750,000, which would have worked out at £24 19s. per head of the population. They would, under the present scheme, have a regular supply of good water at a reasonable rate. The decision to be arrived at was the most momentous the Council had ever been called upon to come to; and its effect would be for an untold number of years. They were engaged that day in making history on a grand scale for Birkenhead; and he fervently hoped that the page, when written, would be such that their successors might look upon it with pride and satisfaction, and applaud their wisdom and foresight.

Mr. MOON seconded the motion.

It was decided, by 36 votes to 9, to discuss the subject with closed doors; and it was nearly three hours before the representatives of the Press were re-admitted. A division was then taken upon the motion, and it was carried by 33 votes to 10.

DERWENT VALLEY WATER SCHEME.

A Fault at the Howden Dam.

It appears from the last report of the Derwent Valley Water Board that a slight check has occurred in the building of the Howden dam. The estimates included 250,000 cubic yards of excavation and 320,000 cubic yards of masonry. On March 15 last, the work done equalled 169,942 cubic yards of excavation and 94,618 cubic yards of masonry; and on the 14th of June, 187,704 cubic yards of excavation and 110,934 cubic yards of masonry—the work done in the intervening period, therefore, being 17,762 cubic yards and 16,316 cubic yards respectively. In further reference to the Howden dam, the report continues: "In cutting the narrow trench, a new fault appeared at a point 40 feet westward of the west tower. It did not show until the trench was between 90 and 100 feet below the original surface, and the trench is being

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carried deeper at this point. On an examination of the portion of the narrow trench which was formerly below the river before its diversion, it was found that a considerable stream of water entered at a point 95 feet below the level of the old river bed, and 18 feet westward of the east tower. It was at first thought this water came from the north side of the trench; but, upon excavating further, it was discovered to be coming from the eastward, and the trench will therefore have to be extended horizontally in that direction." Respecting the Derwent dam, 320,000 cubic yards and 360,000 cubic yards are the respective estimated figures for excavation and masonry; and the work done at the 15th of March was: Excavation, 212,943 cubic yards; masonry, 82,405 cubic yards. The latter figures have now been increased by 14,158 cubic yards and 19,871 cubic yards; making the totals to the 14th of June 227,101 and 102,276 cubic yards. The construction of the length of aqueduct between the Howden and Derwent dams (about 1¾ miles) has been commenced. It is pointed out that the total number of workmen engaged on the various works on June 14 was 1633, and of these 1206 were in the direct employ of the Board. A table at the end of the report shows the net expenditure to have been £1,151,861.

ADDITIONAL WATER SUPPLY FOR NORTHAMPTON.

Local Government Board Inquiry.

An inquiry was recently held, on behalf of the Local Government Board, by Colonel A. J. Hepper, R.E., into an application by the Corporation of Northampton for sanction to borrow £6500 for the purpose of improving the water supply. Of this sum, £3500 was to be utilized for defraying the cost of experimental works at Ravensthorpe, £2000 for the extension of the mains in the borough and in the parishes of Duston and Weston Favel, and £1000 for pumping machinery and the erection of a pumping-station near the Cattle Market in connection with the non-domestic water supply of the borough.

The Assistant Town Clerk (Mr. B. Penny), having furnished the Inspector with particulars as to the population of the town, stated that the outstanding loans under the Public Health Acts totalled £174,761. Mr. Penny was followed by the Water Engineer (Mr. F. Tomlinson), who said the water supply of the borough for all domestic purposes was about 1,600,000 gallons. This was furnished by the existing works. The supply seemed likely to become inadequate, however, and so a report was ordered. It was then shown that the position was so serious that before a reservoir could be constructed the demand might have exceeded the supply. So the Council were advised to sink a well to get water more quickly. The site of it was at Ravensthorpe, and at a considerable distance from the existing deep well. The main from the reservoir could be utilized if the well proved successful. After ascertaining that the reservoir was safe, a trial boring was ordered to determine the nature of the strata. The Council authorized the expenditure of £600 with the intention of charging it to revenue if the works were unsuccessful, and to capital if successful. With their own labour the shaft cost £494. The well was sunk 90 feet, and an idea then prevailed that it was not safe, and tenders were invited to complete the work. The lowest was for £5640; and the estimate, based on the previous experience of driving 2000 feet, was £1649. In the circumstances, the Corporation decided to continue the work. The supply of water had since been gradually increasing. It had been the intention to complete the work and apply to the Local Government Board for a loan when the entire cost was known; and it was on the suggestion of the Board that they were applying for the temporary loan. The value of the water they were getting from the well would justify them in asking for a loan for £100,000; for it was a success beyond all expectations. It had approached to within 20,000 gallons per day of the existing deep well, which was considered the best in the county. They had 250 feet yet to go; and it would be surprising if the well did not even prove the superior one. About a month ago the supply went up from 250,000 to 380,000 gallons per day. This water was being pumped because the men were at work in the well, and it was considered great waste, so they decided to use it for domestic purposes. The driving was therefore properly stopped, and a second well was commenced to meet the first one. Since pumping, the water had risen to within 48 feet of the surface. They had been taking out an average of about 150,000 gallons per day. The £2000 for the extension of the mains was necessary because the amount remaining from the grant under the 1884 Act had been expended—indeed, of the £2000, £465 had been spent during the year. The money raised by the loan would not last for more than two years. This closed the evidence.

Accidental Suffocation by Gas.—Mr. C. P. Johannson, a Swedish merchant, died in the hospital at West Hartlepool last Friday under singular circumstances. He was on his first visit to this country, and on the night of the 11th inst. stayed at an hotel in West Hartlepool. He did not come down to breakfast next morning, and when the room was entered he was found lying on the bed unconscious, with the gas turned on. He never regained consciousness. It was supposed that, being unaccustomed to the use of gas, Mr. Johannson blew it out.

Reduction in the Price of Gas and Coke at Wrexham.—The Directors of the Wrexham Gas Company announce a reduction of 6d. per 1000 cubic feet in the price of gas, and of 1s. 8d. per ton in the price of coke. Discounts for prompt payment will be allowed as follows: Lighting only, 3d. per 1000 cubic feet; cooking, &c. (by separate meter), 6d.; motive power (also by separate meter), 9d. The differential rates for cooking and heating and for motive power are intended to encourage the consumption of gas in the daytime. Prepayment consumers have not been overlooked. It has been decided not to interfere with the meters, which are set to supply 24 cubic feet of gas for 1d., but a cash discount of 3d. per 1000 feet burnt will be returned to the consumers by the collectors. The concession to the coke users brings this fuel down to 10s. per ton.

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NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The Greenock Corporation Gas Department closed a most successful year on June 30. During the twelve months there were carbonized 32,639 tons of coal and 27,906 gallons of benzol; being an increase of 651 tons of coal, but a decrease of 3981 gallons of benzol. The yield of gas per ton was 10,460 cubic feet—an increase of 13 cubic feet over the previous year, and of 835 cubic feet over two years ago. The total yield of gas was 360,141,000 cubic feet, or, corrected for temperature and pressure, 341,414,000 cubic feet—an increase of 7,232,000 cubic feet. There was accounted for 292,042,200 cubic feet—an increase of 7,465,400 cubic feet. Unaccounted-for gas amounted to 49,371,800 cubic feet, equal to 14·46 per cent., as against 14·84 per cent. in the previous year. The high percentage of loss is attributed to the station meter not registering correctly. This is being renewed. The revenue from gas amounted to £40,199—an increase of £120; and from residual products, £7479—an increase of £1040. Of the sum received for residuals, £2415 was derived from the sale of coke and breeze, £1830 from tar, and £3218 from ammoniacal liquor and sulphate of ammonia. Of the sum derived from the sale of gas, £1368 was received through prepayment meters. On the expenditure side, coal cost £16,810; benzol, £927; purifying materials, £900; salaries at works, £737; wages at works, £4511; maintenance of works and plant, £2266; and other expenditure at works amounted to £1226—making, less receipts for old materials, a charge for the manufacture of gas of £27,352. The distribution of gas cost £2063. From gas-stoves (the capital expenditure upon which has been £2606) there was a revenue of £338; and on the expenditure side there is set down for repairs £221, and for depreciation £223. Rents, rates, taxes, and insurance amounted to £2520; and management to £1694. The total revenue was £48,153, and the total expenditure £36,241. There was left a balance to net revenue account of £11,912. Out of this sum there were paid: Instalment of loan, £5000; interest, £2600; income-tax, £291; expended on main and service pipes, £197; and on meters, £999—together £9087. There was left a balance of profit for the year of £2857. The amount of capital expenditure during the twelve months was £3607.

The accounts came before the Town Council on Tuesday, along with a recommendation by the Gas Committee, adopted on the proposal of Provost Denholm, that £2000 of the surplus be transferred to the credit of the Corporation, for the general purposes account. Bailie Forbes, the Convener of the Gas Committee, first moved the adoption of the accounts, and the motion was agreed to. Bailie Forbes then moved that half of the surplus be allocated for the reduction of taxation, and that the other half be carried forward. He said he was as anxious as anyone to see the price of gas reduced, but, for various reasons, he did not think this was the time for them to face that step. Provost Denholm said that since the meeting of the Committee he had gone carefully over the figures, and consulted with the Town Chamberlain and the Gas Manager, and he thought they could quite safely alter the £2000 proposed to £1700 as the sum to be paid over to the Corporation general purposes account, and apply the balance to the reduction of the price of gas by 1d. per 1000 cubic feet. In reducing the gas to 2s. 8d. per 1000 cubic feet, they would bring it down to what it was in Paisley. Mr. T. Mitchell moved that a reduction of 2½d. per 1000 cubic feet be made, as from the collection in May last. Mr. T. Baxter had always spoken in favour of the principle of applying the surplus to the reduction of the price of gas, because it acted as an incentive and encouragement to the Manager, the Committee, and the consumers. Mr. D. Cowan pointed out that the gas undertaking was owned by the Corporation, and borrowed money on the credit of the Corporation, and he thought it fair that the ratepayers should get some benefit for the risks which they ran in connection with the gas-works. After some further discussion, the proposal of Provost Denholm was adopted by a majority.

The Corporation of Edinburgh last year spent £45,000 upon public lighting. Less than twenty years ago, the annual expenditure was £14,000. That the expenditure has risen to three times the amount it was then is not due to the extension of the city borders by nearly so much as it is to the higher standard of lighting now demanded.

On Thursday, the Corporation of Glasgow fixed their police assessments for the year. Mr. Brechin, in proposing the assessments, which are ½d. in the pound higher than last year, said that on the lighting of the city £3500 or thereby additional would be spent—£1800 on wages, and £1700 on gas; the former due to an advance in rates of pay and additions to the staff, and the latter to more lights and increased consumption.

Yesterday a Committee of the Aberdeen Town Council had before them the estimate for the lighting of the city for the current year. The expenditure last year was £12,750, which was £66 above the estimate; and for the current year the sum has been fixed at £12,800. The same Committee had before them a report by the Electrical Engineer upon a proposal to substitute electric for gas lighting in three leading thoroughfares in the city. The report was to the effect that the change would involve a capital outlay of £1603 for the sixty lamps required, and that the annual charge would be £686 more than is at present paid for gas. The Committee, by seven votes to four, resolved to abide by gas lighting for the thoroughfares in question.

The Town Council of Glasgow had on Thursday what may be termed their annual wrestle with the black smoke nuisance. It came before the Council in a recommendation by a Sub-Committee, to the effect that in view of the opinion expressed by the Sanitary Inspector, that 90 per cent. of the smoke offences resulted from careless firing, they had agreed to report that the powers at present possessed by the Local Authority under the Public Health (Scotland) Act of 1897—by which proceedings for smoke offences can only be instituted against the owner or occupier of the premises from which excessive smoke may be

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emitted—are inadequate; and they recommended that powers be obtained similar to those in the Nottingham Improvement Act of 1874, and in the Alkali Act, which provide for the prosecution of any engineer, fireman, stoker, foreman, or other person who negligently uses any fireplace or furnace constructed so as to prevent or burn the smoke arising therefrom in such a manner as that the smoke is not effectually prevented or burnt; and that it be remitted to the Parliamentary Bills Committee to incorporate a clause to this effect in the next Provisional Order to be promoted by the Corporation. The minute was adopted.

At last week's meeting of the Glasgow Town Council, Mr. Miller asked if, in view of the very defective lighting obtaining in most of the private streets and courts in the city, and in view also of the fact that the Corporation had been twice refused the power to levy a rate sufficient to permit of the introduction of incandescent lighting, the Convener of the Watching and Lighting Committee would take steps forthwith to arrange a conference between his Committee and proprietors interested, for the purpose of amicably settling a difficulty which at present operates against both landlords and tenants. Mr. Cleland reminded Mr. Miller that the Corporation had resolved to make a third attempt in the direction indicated by him, and that the matter was accordingly in the hands of the Parliamentary Bills Committee. Then, in this week's meeting of the Council, Treasurer Stevenson asked whether, in view of the fact that this year's estimate for lighting private streets and courts showed a probable expenditure of £7679, as against £4407 of revenue, and for lighting common stairs an expenditure of £45,183, as against £25,340 of revenue, the Convener of the Parliamentary Bills Committee would tell the Council what steps they were taking to remedy this state of matters. Mr. Gray said the subject was one which would be dealt with in the next Provisional Order.

The annual meeting of the shareholders of the Nairn Gas Company, Limited, was held on Monday. The Directors reported that the carrying out of the extensions and improvements sanctioned by the shareholders in March of last year had interfered to some extent with the past year's working; but they considered that, in the circumstances, the state of the profit and loss account was satisfactory. In consequence of the extensions and improvements referred to, there fell to be written off capital the value of old property and plant which had been demolished, and the depreciation of old works still existing, which, together, the Directors estimated at £2185. They had placed this sum to a suspense account, but had written off it, out of the profits for the year preceding last, £450, and out of last year's profits, £126; leaving a balance of £1608 in the suspense account. A dividend of 4 per cent. was declared out of profits, leaving £107 to be carried forward. All the work referred to has been carried out under the supervision of the Manager, Mr. J. Barker.

In connection with a Cycle Carnival held last month at Warrington, the Richmond Gas Stove and Meter Company, Limited, were awarded the first prize for a vehicle tableau; the subject illustrated being the difference between cooking in the old days and under the improved conditions now existing.

CURRENT SALES OF GAS PRODUCTS.

Week ending Aug. 25.

In the London market, notwithstanding the holiday season, there has been considerable business done in tar products—of course, for forward delivery. Continental consumers are willing to pay advanced prices, and contracts are stated to have been made at slightly under the makers' quotation of 32s. Benzol is also strong; while toluol and solvent naphtha are in demand, though scarce. 60's crude carbolic acid and crystals are unchanged. Ordinary London creosote remains at 2¼d. net in bulk at makers' works. Sulphate of ammonia continues to hold its own, and there is no alteration to report in the price.

Sulphate of Ammonia. LIVERPOOL, *Aug.* 25.

There has been fair demand at most ports, but it has not been enough to bring about any further improvement in values. Quotations therefore remain at £11 17s. 6d. per ton f.o.b. Hull, and £12 per ton f.o.b. Liverpool and Leith; and these prices have been paid for September delivery. For October-December £12 5s. per ton, for October-March £12 7s. 6d. per ton, and for January-April £12 10s. per ton, are the quotations; but these prices are rather above buyers' ideas, and meantime business hangs fire. Consumers abroad have not made up their minds to this advance, and they are encouraged in their attitude by speculators, who are again offering for delivery ahead at but a moderate premium on spot prices.

Nitrate of Soda.

This article is very firm in all positions, and spot prices are 11s. 4½d. per cwt. for 95 per cent. and 11s. 9d. for refined. The forward position also tends to harden.

Tar Products. LONDON, *Aug.* 27.

Things have remained practically unchanged during the past week; but prices are well maintained, especially for forward delivery. The tone of pitch is firm, and manufacturers are not disposed to entertain any business for forward delivery except at enhanced prices. Good offers are reported to have been refused on the East Coast for delivery from now till the end of the year; and as regards January-June, makers have several times been asked to quote, but have refused to do so, believing in still better prices later on. Some quantity has been offered for prompt delivery at a good port on the East Coast at 28s. per ton; but there is no definite information as to whether this has been accepted. As regards London, pitch makers do not appear anxious to sell for prompt delivery; while for forward, the principal companies quote from 31s. 6d. to 32s., which prices, however, they are quite unable to obtain. There is still a fair amount of buying going on in South Wales for October-March delivery, but in this district low prices

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	Cub. Ft. Daily.		Cub. Ft. Daily.		Cub. Ft. Daily.
Blackburn	1,250,000	Winnipeg, Man.	500,000	Malton	150,000
Windsor St. Works, Birmingham	2,000,000	Colchester (Second Contract)	300,000	Smethwick	500,000
Saltley Works, Birmingham	2,000,000	York	750,000	Gravesend	300,000
Colchester	300,000	Rochester	500,000	Pernambuco, Brazil	125,000
Birkenhead	2,250,000	Kingston, Ont.	300,000	Duluth, (Second Contract)	300,000
Devizes	120,000	Crystal Palace District	2,000,000	Leicester (Second Contract)	1,000,000
Saltley, Birmingham (Second Contract)	2,000,000	Duluth, Minn.	300,000	Newport (Second Contract)	250,000
Windsor St., Birmingham (Second Contract)	2,000,000	Caterham	150,000	Brockville	250,000
Halifax	1,000,000	Leicester	2,000,000	Toronto (Third Contract)	750,000
Toronto	250,000	Enschede, Holland	150,000	Montreal, Ont. (Second Con.)	1,800,000
Ottawa	250,000	Buenos Ayres (River Plate Co.)	700,000	Toronto (Fourth Contract)	1,000,000
Lindsay (Remodelled)	125,000	Burnley	1,500,000	Hamilton, Ont.	400,000
Montreal	500,000	Kingston-on-Thames	1,750,000	Rochester (Third Contract)	1,600,000
Toronto (2nd Cont., Remodelled)	2,000,000	Accrington	500,000	Leeds (Second Contract)	900,000
Belleville	250,000	Tonbridge	300,000	Buenos Ayres (Primitiva Co.)	1,200,000
Ottawa (Second Contract)	250,000	Stretford	500,000	Buenos Ayres (New Co.)	1,200,000
Brantford (Remodelled)	200,000	Oldbury	300,000	Christchurch, N.Z.	300,000
St. Catherines (Remodelled)	250,000	Todmorden	500,000	Rochdale	1,600,000
Kingston, Pa.	125,000	Saltley, Birmingham (Third Contract)	2,000,000	St. John's, Newfoundland	250,000
Peterborough, Ont.	250,000	York (Second Contract)	750,000	Brantford (Second Contract)	400,000
Wilkesbarre, Pa.	750,000	Rochester (Second Contract)	500,000	Smethwick (Second Contract)	500,000
St. Catherines (Second Cont.)	250,000	Newport (Mon.)	250,000	Pontypridd	250,000
Buffalo, N.Y.	2,000,000	Tokio, Japan	1,000,000	Montreal (Third Contract)	1,800,000
		Newcastle-on-Tyne	1,800,000	Guelph, Ont.	350,000
		Leeds	1,800,000	Buenos Ayres (River Plate Co.) Second Contract	750,000
				Belgrano (River Plate Co.)	500,000

And, in addition, COAL GAS PLANTS at NELSON, B.C., CHATHAM, BERLIN, NAPANEE, OWEN SOUND, CALGARY, and WINNIPEG.

are reported to have been accepted. One or two makers on the west coast appear rather anxious to clear out small quantities for prompt delivery, and low prices are asked. For forward delivery they are very firm, and some high prices are spoken of. The market for creosote is firm. Business is still reported at good prices from America; and the London manufacturers are undoubtedly very firm in their ideas, being well sold and not inclined to do any further business except at an advance upon previous prices. In the Midlands, manufacturers are reported to have refused 1¾d. for very fine quality oil upon their works, while in the North manufacturers ask the same price; but 1½d. has been accepted, *ex* works, for a small quantity of good quality. No business is reported in anthracene, and during the past week the values have remained quite unchanged. In carbolic acid, Continental consumers still refuse to offer more than 1s. 9d., which price manufacturers will not accept. No business is reported in crystals, and values remain unchanged at 6d. for 39-40's and 5¾d. for 34-35's. Business in toluol is reported to have been done on the east coast at 1s. 1½d. per gallon till the end of the year, and London manufacturers still ask 1s. 2d. for any small quantity they may have available. For 90 per cent. benzol, there appears to be a fair demand. London manufacturers are asking 9¾d. f.o.b., while business is reported to have been done in the North at equal to 9½d. to the end of the year. In 50-90 per cent. there does not appear to be much business doing, as the quantities offering are small; but one or two sales are reported to have taken place for delivery up till the end of the year, and 11½d. is stated to have been accepted for the same period on the East Coast. No confirmation of this sale has yet been obtainable.

The average values during the week were: Tar, 15s. 9d. Pitch, London, 27s. 9d. to 28s. 3d.; east coast, 27s. 6d. to 28s.; west coast, 26s. to 27s. Benzol, 90 per cent., 9¾d. to 9¾d.; 50-90 per cent., 11d. to 11½d. Toluol, 1s. 1½d. to 1s. 2d. Crude naphtha, 4d. to 4¼d.; solvent naphtha, 1s. 1d. to 1s. 2½d.; heavy naphtha, 11½d. to 1s. 1d. Creosote, London, 1⅞d. to 2d.; North, 1½d. to 1⅝d. Heavy oils, 2¼d. Carbolic acid, 60 per cent., 1s. 9d. to 1s. 9½d. Naphthalene, £4 10s. to £9 10s.; salts, 26s. to 27s. 6d. Anthracene, "A" quality, 1½d. to 1⅝d., "B" quality unsaleable.

Sulphate of Ammonia.

The market has been steady during the past week, but without much alteration in prices, although they have, on the whole, had an upward tendency. In London, business is reported to have been done at £11 16s. 3d. on Beckton terms; but this was probably for a make the quality of which was not first class. The principal London Gas Companies themselves quote £12 2s. 6d. for prompt and £12 10s. for forward. In Hull, business is reported in a very fine make for prompt delivery at £12 2s. 6d. per ton; but the ordinary value may be taken as from £11 18s. 9d. to £12. In Leith, manufacturers refuse to quote anything under £12 2s. 6d. for September, and state that they are fully sold for the present month. In Liverpool, no business of importance is reported; but £12 is said to have been paid for September shipment.

COAL TRADE REPORTS.

Lancashire Coal Trade.

The very warm weather experienced in Manchester and the County Palatine last week, coupled with the continuation of the holiday season on a scale hitherto unprecedented in Lancashire, caused some check in the demand for house coal which had set in previously. A little more gas coal and cannel is going out under contract. Steam coal is in steady demand, and shipping coal rather quieter. The average quotations were: Best house coal 13s. to 14s. per ton at the pits, secondary 12s. to 13s., common 9s. to 10s., steam and forge 8s. to 9s., best engine fuel 7s. 6d. to 8s. 6d., best slack 6s. 9d. to 7s. 6d., medium 6s. to 7s., common 5s. to 6s. The price of furnace coke varies from 17s. to 24s.

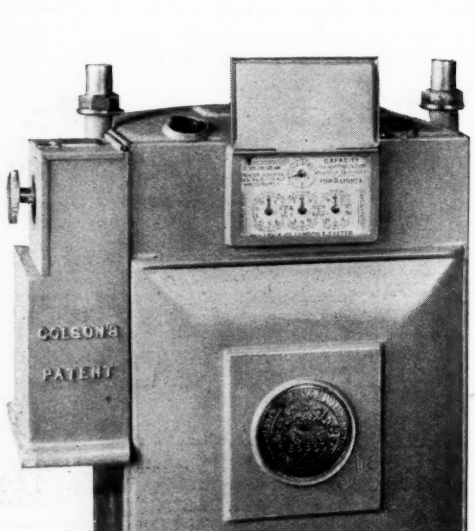
Northern Coal Trade.

The demand for coal is still generally very full, with perhaps slightly less pressure in the demand for one or two classes, and with occasionally a lower quotation for some qualities. In the steam coal trade, best Northumbrians are from 10s. 10½d. to 11s. per ton f.o.b., second-class steams are 10s. to 10s. 3d., and steam smalls are steady at from 6s. to 6s. 3d. In the Durham coal trade, nearly all classes are firm; and there is an especially strong demand for some of the best kinds of gas coal. Prices for occasional sales vary from 10s. to 11s. 3d. per ton f.o.b, and for one or two kinds even higher quotations have been made. Coke is firmer on the whole; and this has benefited gas coke. From 10s. 6d. to 11s. 3d. per ton may be considered as the current f.o.b. prices.

Scotch Coal Trade.

A strong demand continues, and orders are being placed freely. Prices for forward delivery show no sign of giving way, while current rates for all sorts are easily maintained. The prices quoted are: Main, 7s. 9d. to 8s. per ton f.o.b. Glasgow, ell 8s. 9d. to 10s., and splint 9s. 3d. to 9s. 6d. The shipments for the week amounted to 307,117 tons—a decrease upon the preceding week of 13,728 tons, but an increase of 14,787 tons upon the same week of last year. For the year to date, the total shipments have been 8,547,992 tons, an increase of 945,576 tons upon the corresponding period.

The Proposed Conversion of Gas-Lamps to Flame Arcs at Hastings.—The Hastings Town Council have not obtained the sanction of the Local Government Board to the small loan required for the further conversion of gas-lamps to electric lighting. This refers to the loan, the subject of inquiry when the Inspector pretty clearly intimated that the cheap gas-lamps now in use were sufficiently efficient without going to greater expense; and it was also proved that the proposed cost of the flame arcs it was intended to erect only included the general costs of the electricity. This has nothing to do with the plan for the wholesale conversion of the ancient arcs in the borough.



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The Explosion at the Bedford Gas-Works.

In the last number of the "JOURNAL," we briefly noticed an explosion which took place in the purifier-house at the Bedford Gas-Works the previous evening. It appears that between half-past seven and eight o'clock, the Resident Engineer (Mr. Thomas Dann), who had just returned home from his holidays, heard the report of an explosion. Hurrying to the works, he found that it had occurred, as stated, in the purifier-hour, where some repairs had been going on during his absence. On these, two men from London (Harry and James Houghton) had been engaged, assisted by three of the Company's employees. Mr. Dann, with the aid of the workmen, at once got out the men and sent for a doctor, who ordered four of them to go to the Hospital. Harry Houghton was the most injured, as he was suffering from severe scorching of the skin and bruises; and he was the only one detained. His injuries were, however, not so serious as to need a prolonged stay. The damage done to the plant and building was only slight. The work on which the men were engaged was riveting; and the explosion is supposed to have been due to red-hot rivets coming in contact with a mixture of gas and air. We understand that the men were working in direct opposition to orders left by Mr. Dann; and consequently no blame attaches to the Company's officials. What had been done the previous fortnight towards repairing the purifiers has been undone by the explosion.

The Testing of Meters.

The deputation appointed by the Manchester City Justices to visit the gas-meter testing-stations of the London County Council, the City of London Corporation, the Middlesex County Council, and the Corporation of Nottingham, report that at all the stations visited, with the exception of that at Nottingham, gas is used for the registration test of every class of meter. In Manchester, gas is employed for the 3-inch pressure test for soundness of meters, as specified in clause 13 of the Sale of Gas Act, 1859. The same clause leaves it optional for the inspectors to use either gas or air for the registration test of meters. Air is used in the Manchester testing office, and except for the plausible reason that "gas-meters should be tested with gas," the deputation think there is no advantage in the use of gas to compensate for several grave disadvantages. During their tour, the deputation paid a visit to an electricity-meter testing office in London. On this point they say that, "among consumers of electricity and water, there is a growing feeling that, their case being analogous to that of gas consumers, there ought to be established some independent authority for testing the apparatus of measurement, similar to that founded by the Justices' Committee under the Sale of Gas Act, 1859, for testing gas-meters. Naturally the feeling is particularly strong among the users of electricity for lighting purposes, as they notice the absence in the meters for the new illuminant of the independent testimony to accuracy which is given by the seal of the testing station in the case of gas-meters; and the deputation, after full inquiry, are of opinion that it should be made compulsory by Act of Parliament for the sellers of electricity or water to supply meters which have been tested and sealed by an independent authority."

Bursting of the Liverpool Water-Main.—The 42-inch Vyrnwy main of the Liverpool Corporation burst on Saturday night beneath the bed of the River Elfee, which it crosses between Malpas and Oswestry—the point where the pressure is the greatest throughout the whole length of the system, being 260 lbs. per square inch. During the laying of the second main, a leakage was discovered, and endeavours were made to trace it. When the workmen had left for the week-end, there was a violent explosion, and a huge column of water rose 100 feet into the air, carrying on its crest heavy masses of masonry and pieces of rock; while tons of earth and shingle were torn down from the hillside and filled up the river bed. The water was thrown up for half-an-hour, until the automatic controlling valves came into action and stopped it. The Contractor says that had the accident occurred during working hours the whole of the staff in the shaft must have been drowned. It was discovered on Sunday that a piece 2 feet by 1 foot had been blown from the side of the pipe.

Improved Lighting of the Parish Church at Yarmouth.—Under the heading "Notes of the Week" in the "Yarmouth Independent" for last Saturday, "J." made the following remarks on the above matter: "The lighting of the Parish Church is a subject that affects the comfort of thousands of our townspeople, and it is a common source of delight, therefore, that it is being improved in a remarkable manner. A few at a time, the present gas standards are being removed for the purpose of being cleaned, re-lacquered, and fitted with a new burner. I have seen one of the standards as completed. It is a remarkably effective one, with four branches, two of which are to bear the new light, and the others adapted for a flat-flame burner as an auxiliary in case of emergency and for warming the church in the depth of winter. The new burners are of a special design, and each is capable of giving light of the brilliancy of nearly 100 candles. The stability of the light is assured by the construction of the burner in such a way that the body which carries the incandescent mantle and the globe holds them suspended upon a series of delicate springs which render them unsusceptible to any vibration, and considerably prolongs the life of the mantle. The burner has been brought under control, too, in another way, so as to permit of the light being modified as desired during service, with a view to economizing gas. The wisdom of the Church Council in choosing the incandescent gas system of lighting the nave of our immense church is already apparent, and will become more so when the new installation is completed. Thus Yarmouth's Parish Church has been brought into line with such notable churches as Canterbury and Glasgow Cathedrals, the large parish churches at Swansea, Brighton (St. Peter's), Sherborne, Barnstaple, Newmarket, and elsewhere, and also the church of St. Katherine Cree in the City, and many others of like prominence."

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Essex Short of Water.—Coggeshall, in Essex, like Corringham (*ante* p. 593), is suffering from an inadequate supply of water. The village has only one pump, and this is at the top of a hill, and is kept locked for a great part of the day and during the night. At seven o'clock each morning it is opened by an official of the Parish Council. But for over an hour before this the representatives of the families begin to arrive, each armed with a couple of buckets. When the lock is unfastened the fight for the pump-handle begins. The pump ran dry last Tuesday in a quarter-of-an-hour, and only a few of the assembled hundreds had secured a bucketful of water. Those who are unsuccessful have to wait until the afternoon, when a waggon laden with barrels of water makes its appearance, and two small bucketfuls are ladled out to each household. For this each person pays 1d. per week, while the Council pay the water-carrier a subsidy. It is stated that a mile or two outside the village there are many springs of fine water.

The Manchester Explosion.—According to the report of an official inspection of the scene of the explosion in Victoria Street, Manchester, noticed in the "JOURNAL" last week, it was found that the electrical distributing mains laid in 1898 had been burnt away for a distance of about 6 feet. "The fusing of the mains commenced at a point where the service wires to the premises of Messrs. Williams left the distributing mains. No actual reason can be given for the failure of the service wires at their junction with the distributing mains, but such faults are generally believed to be due to the presence of some foreign substances in the bitumen, an insufficient electrical contact between the mains and the service wires, to the existence of water which has gathered into the bitumen from the streets, or to the subsidence of the ground under the mains. In the present case, the expert view is that the heat generated by the fusion of the wires volatilized the bitumen, and the gases given off in all probability found their way into the premises of Messrs. Williams, where the first explosion took place."

The Hayfield Gaslight and Water-Works Company, Limited, instructed the Richmond Gas Stove and Meter Company, Limited, to hold an exhibition and thoroughly canvass the district. They are also to fit up complete automatic installations, including a gas-cooker.

The Y.M.C.A. buildings in Belfast have just been fitted up with Selas burners by Messrs. John Dowling and Sons, the local agents for this light. These are first buildings in Belfast to be lighted by the system named; and the results, especially from an economic standpoint, will be watched with interest during the ensuing winter. It is stated that the cost of lighting the premises by electricity is about £270 per annum; and it is predicted that the annual gas bill under the new arrangement will not exceed £75.

WANTED, FOR SALE, CONTRACT, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Situations Vacant.

STATION SUPERINTENDENT. Nottingham Gas Department. Applications by Sept. 27.
GENERAL FOREMAN. Tottenham Gas Company. Applications by Sept. 17.
DRAUGHTSMAN (General). No. 4638.
MAINTENANCE DEPARTMENT. No. 4643.
RENTAL CLERK. No. 4642.
CLERK. No. 4644.

Situations Wanted.

REPRESENTATIVE. No. 4641.
LIGHTING OR WATER ENGINEER (Foreign and Colonial). No. 4633.
WORKS FOREMAN. No. 4639.

Company Meeting.

OTTOMAN GAS COMPANY. London Office, Sept. 11. One o'clock.

Plant (Second-Hand) Wanted.

GASHOLDER, PURIFIERS, &c. No. 4637.

Plant for Sale.

ENGINEERING PLANT, MACHINERY, TOOLS, &c. (Graham, Morton, Ltd.) Catalogues now ready. By Auction on Sept. 4, 5, 6, and 7.
ENGINES, PUMPS, &c. South Staffordshire Water-Works Company.

Plant for Sale—*(Continued.)*

CORNISH BOILER AND STEEL CHIMNEY. Redditch Gas Company.
DRY METER (250 Light). Pryce Jones, Ltd., Newtown.
EXHAUSTER, GOVERNOR, VALVES, &c. Keighley Gas-Works.

TENDERS FOR

Coke.

RAMSGATE GAS AND WATER DEPARTMENT. Tenders by Sept. 10.

Gasholder, Tank, and Connections.

HALESWORTH GAS COMPANY.

GAS COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 569

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
590,000	10	Apl. 11	10½	Alliance & Dublin 10 p.c.	21—22	..	4 15 5
160,000	10	,,	7½	Do. 7 p.c.	14⅜—15⅜	..	4 16 9
200,000	5	May 11	7	Bomt 1y, Ltd.. . . .	6¾—7¼	..	4 16 7
40,000	5	,,	7	Do. New, £4 paid	5—5⅜	..	5 1 10
50,000	10	Mch. 9	14	Bourne-) 10 p.c. . .	28½—29½	..	4 14 11
51,810	10	,,	7	mouth Gas) B 7 p.c. .	17—18	..	4 17 9
53,200	10	,,	6	and Water) Pref. 6 p.c.	15⅝—16⅝	..	3 12 9
380,000	Stk.	Aug. 15	12½	Brentford Consolidated	260—265*	..	4 14 4
300,000	,,	,,	9½	Do. New . . .	198—203*	..	4 13 7
50,000	,,	,,	5	Do. 5 p.c. Pref. .	120—125	..	4 0 0
206,250	,,	June 14	4	Do. 4 p.c. Deb. .	103—106	..	3 15 6
220,000	Stk.	Mch. 9	11½	Brighton & Hove Orig.	234—239	..	4 14 2
246,320	,,	,,	8½	Do. A. Ord. Stk. .	167—172	..	4 15 11
260,000	20	Apl. 11	10	British	41⅞—42⅛	..	4 14 1
104,000	Stk.	Aug 15	6	Bromley, Ord. 5 p.c. .	119—123*	..	4 17 7
165,700	,,	,,	4½	Do. do. 3½ p.c. .	90—95*	..	4 16 9
500,000	10	May 11	7	Buenos Ayres (New) Ltd.	12⅛—12¾	..	5 9 10
250,000	Stk.	June 28	4	Do. 4 p.c. Deb. .	96—98	..	4 1 8
150,000	20	July 12	8½	Cagliari, Ltd.	24—26	..	6 6 11
100,000	10	June 14	10	Cape Town & Dis., Ltd.	15—16	..	6 5 0
100,000	10	Apl. 26	4½	Do. 4½ p.c Pref.. .	9⅝—10¼	..	4 7 10
50,000	50	May 2	6	Do. 6 p.c. 1st Mort.	52—54	..	5 11 1
50,000	Stk.	June 28	4½	Do. 4½ p.c. Deb. Stk.	98—100	..	4 10 0
1,443,280	Stk.	Feb. 22	5⅛	Commercial 4 p.c Stk. .	115—117	..	4 8 10
560,000	,,	,,	5	Do. 3½ p.c. do. .	112—114	..	4 7 9
475,000	,,	June 14	3	Do. 3 p.c. Deb. Stk.	84—86	..	3 9 9
800,000	Stk.	,,	6⅔	Continental Union, Ltd.	123—126	..	5 3 2
200,000	,,	,,	7	Do. 7 p c. Pref.	140—145	..	4 16 7
432,070	Stk.	Aug.	5½	Derby Con. Stk. . . .	122—124	..	4 8 9
55,000	,,	July	4	Do. Deb. Stk. . . .	105—107	..	3 14 9
486,090	10	July 27	11	European, Ltd. . . .	24—25	..	4 8 0
354,060	10	,,	11	Do. £7 10s. paid	18—19	..	4 6 10
15,203,110	Stk.	Aug. 15	4⅛	Gas-) 4 p.c. Ord. . .	98⅛—97½*	+⅛	4 8 5
2,600,000	,,	,,	3⅜	light) 3½ p.c. max. .	87—89*	..	3 18 8
3,799,735	,,	,,	4	and) 4 p.c. Con. Pref.	107—110*	+1	3 12 9
4,193,975	,,	June 14	3	Coke) 3 p.c. Con. Deb.	86—88	..	3 8 2
258,740	Stk.	Mch. 9	5	Hastings & St. L. 3½ p.c.	100—105	..	4 15 3
82,500	,,	,,	6⅔	Do do. 5 p.c.	121—124	..	5 4 10
70,000	10	Apl. 11	11	Hongkong & China, Ltd.	20—21	..	5 4 9
940,000	Stk.	May 11	8	Imperial Continental .	183—186	..	4 6 0
473,600	Stk.	Aug. 15	3½	Do. 3½ p.c. Deb. Red.	95—97*	..	3 12 2
183,242	Stk.	Mch. 26	6	Lea Bridge Ord. 5 p.c. .	122—127	+1	4 14 6
£			p.c.				£ s. d.
561,000	Stk.	Feb. 22	10	Liverpool United A . .	235—237	..	4 4 5
718,100	,,	,,	7	Do. B . .	172—174	+2	4 0 6
306,083	,,	June 28	4	L'rpool Unit'd Deb. Stk.	107—109	..	3 13 5
75,000	5	June 28	5	Malta & Medn., Ltd. .	4¼—4⅜	..	5 5 3
560,000	100	Apl. 2	5	Met. of) 5 p.c. Deb..	103—105	..	4 15 3
250,000	100	,,	4½	Melbourne) 4½ p.c. Deb.	102—104	..	4 0 7
541,920	20	May 31	3⅜	Monte Video, Ltd. . .	11—12	..	5 16 8
1,675,892	Stk.	Aug. 15	4	Newc'tle & G'tesh'd Con.	1 0—1 12*	..	4 2 7
406,025	Stk.	June 29	3⅜	Do. 3½ p.c. Deb.	97—99	..	3 10 8
15,000	10	Mch. 9	10	North Middlesex 10 p.c.	20—21	..	4 15 3
55,940	10	,,	7	Do. 7 p.c.	13½—14½	..	4 16 7
300,000	Stk.	May 11	8	Oriental, Ltd. . . .	150—153	..	5 4 7
60,000	5	Mch. 28	7	Ottoman, Ltd. . . .	6—6½	..	5 7 8
398,490	5	Apl. 26	7	Primitiva Ord. . . .	6¾—7¼	..	4 16 7
796,980	5	July 27	5	Do. 5 p.c. Pref. .	5⅛—5⅜	..	4 13 0
488,900	100	June 1	4	Do. 4 p.c. Deb. .	96—98	+1	4 1 8
851,070	10	Apl. 26	7	River Plate Ord. . . .	12½—13	—¼	5 7 8
300,000	Stk.	June 28	4	Do. 4 p.c. Deb. .	96—98	..	4 1 8
250,000	10	Mch. 28	8	San Paulo, Ltd. . . .	14¼—14⅜	..	5 5 8
70,000	50	July 2	5	Do. 5 p.c. Deb. .	49—51	..	4 18 0
135,000	Stk.	Mch. 28	10	Sheffield A	244—246	..	4 1 4
209,984	,,	,,	10	Do. B	243—245	..	4 1 8
523,500	,,	,,	10	Do. C	243—245	..	4 1 8
70,000	10	May 31	10	South African	16—17	..	5 17 8
6,350,000	Stk.	Aug. 15	5½	South Met., 4 p.c. Ord.	131—133*	..	4 2 8
1,895,445	,,	July 12	3	Do. 3 p.c. Deb.	86—88	..	3 8 2
575,000	Stk.	Aug. 15	5½	S'th Suburb'n Ord. 5 p.c.	122—125*	..	4 8 0
60,000	,,	,,	5	Do. 5 p.c. Pref. . .	123—126*	..	3 19 4
112,533	,,	July 12	5	Do. 5 p.c. Deb. Stk.	128—133	..	3 15 2
502,310	Stk.	May 11	5	Southampton Ord. . .	107—112	..	4 9 3
120,000	Stk.	Mch. 9	6¼†	Tottenham) A 5 p.c. .	127—130	..	5 0 0
388,020	,,	,,	5†	and) B 3½ p.c. .	102—105	..	4 15 3
137,500	,,	June 28	4	Edmonton) 4 p.c. Deb.	103—105	..	3 16 2
182,380	10	June 14	8	Tuscan, Ltd.	10¼—10¾	..	7 8 10
149,900	10	July 2	5	Do. 5 p.c. Deb. Red.	100—103	..	4 17 1
30,000	Stk.	Aug. 15	8	Wands-) A 5 p.c. . .	—	..	—
255,636	,,	,,	6¼	worth) B 3½ p.c. . .	135—146*	+2	4 12 10
75,000	,,	,,	5⅝	and) C 3½ p.c. . .	110—113*	..	4 19 1
79,416	,,	June 28	3	Putney) 3 p.c. Deb. Stk.	82—85	..	3 10 7
779,875	,,	Aug. 15	5⅛	West Ham 5 p.c. Ord.	105—107*	..	4 15 9
185,000	,,	,,	5	Do. 5 p.c. Pref.	120—123*	..	4 1 4
193,300	,,	June 28	4	Do. 4 p.c. Deb. Stk.	104—107	..	3 14 9

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